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NATURAL HISTORY

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AMERICAN MUSEUM OF NATURAL HISTORY

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1941

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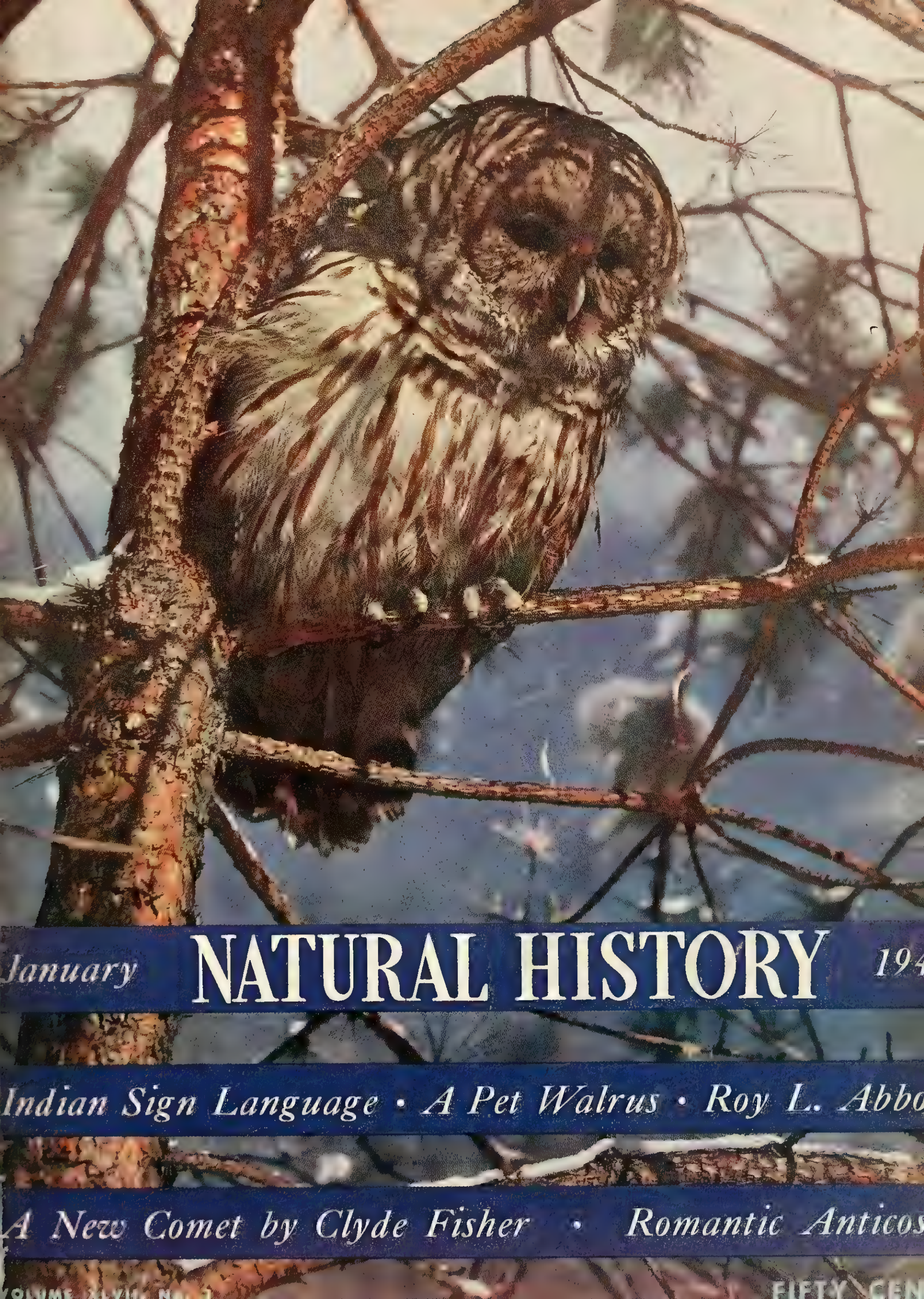

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NATURAL HISTORY

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A New Comet by Clyde Fisher • Romantic Anticos

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FIFTY CEN

Natural History

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LETTERS

Sirs:

Knowing of your interest in rarities, I present the accompanying photograph of a European fern which has mysteriously become naturalized in only one small spot in the entire United States. This is the European Hart's-tongue fern, *Phyllitis scolopendrium* (L.) Newman.

That one small growth of the fern should be found so far from its homeland is one of those riddles which add to the fascination of botany. How and from where it originated is unknown to the occupants of the farm on which it occurs, Mr. and Mrs. Theodore Lurman, who live near Darlington, Maryland, and to botanists who have visited the locality for years. I have traced its history back 80 years. It is supposed that the spores were accidentally imported with other seeds many years ago and have since been developed in the cool, dark, damp ram-pit (a type of surface well, about eight or ten feet deep, stone lined, with a spring in the bottom), where the fern has found conditions similar to its native habitat in Europe.

The colony forms a ring about three feet below the top of the ram-pit, with fronds hanging down from twelve to 20 inches in length. The fronds are evergreen and are protected from summer heat and drought and from winter freezing by a lattice covering the top of the ram-pit. Seemingly enough sunlight enters through the lattice to support the growth of this fern. There are about 80 plants in the colony.

This is the only locality known in the United States where the existence is truly accidental. Reports of two other localities in New York and northern Illinois respectively, each containing a pair of plants, are explained by the fact that the Brooklyn Botanic Garden sent out two specimens of it to persons who paid the postage. There is also a report of two from Iowa. But the Maryland site remains the only one where the fern has become naturalized and is flourishing. Specimens from this source can be seen in the herbarium of the Maryland Academy of Sciences, at Baltimore.

Clyde F. Reed,
Curator of Botany.

Maryland Academy of Sciences,
Baltimore, Md.

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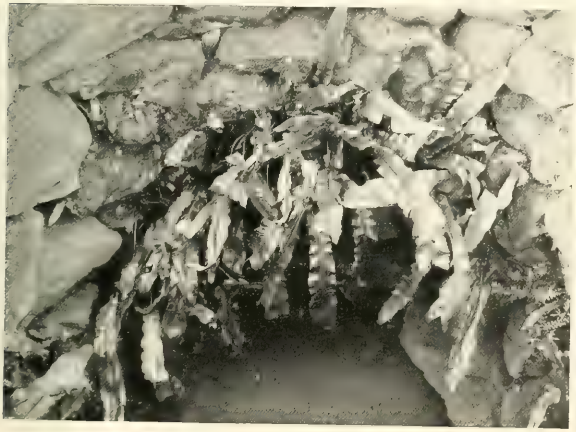

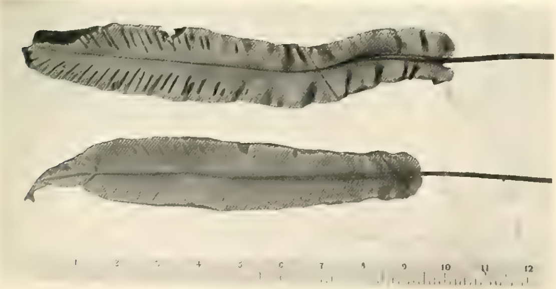

Fronds of the Hart's-tongue fern

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LETTERS

[illegible]

[illegible] information on this falls, I refer you to [illegible] *National Geographic Magazine*, where is [illegible]

I hope this correction is mentioned in [illegible] admirer of your magazine.

[illegible]

Carolina Sandhills National Wildlife [illegible]
McBee, South Carolina.

[illegible]

In sending you a membership renewal [illegible] for NATURAL HISTORY headed his Christmas list. We were sure it was too mature a magazine for him, but he was so very sure that it was just what he wanted that we yielded.

He reads it each month several times from cover to cover and then anxiously [illegible] He really loves it. . . .

W[illegible] this fall, and the American Museum was definitely the highlight of the trip. . .

[illegible]

Corning, N. Y.

. . .

[illegible]

[illegible] Linnaeus) in the mountains inland from Vallenar, Chile, South America. In the nest was a young male condor about four months old (shown in the photograph at left).

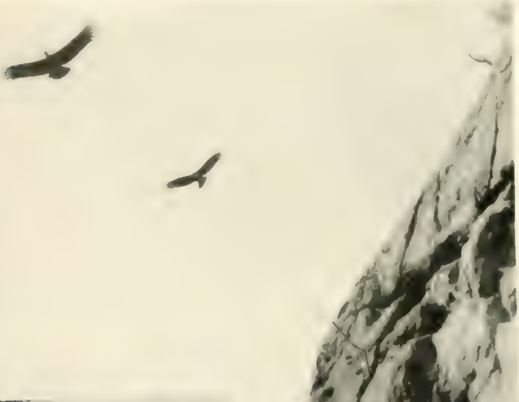
I was soon attacked by the two parent [illegible] to get a snapshot of both parent birds in the air with their outstretched legs ready to attack; the male is in the top left corner.

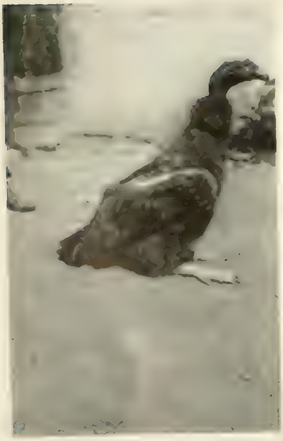
Although locally exterminated, condors are still found in the Andean mountains. They breed in large caves on practically inaccessible cliffs; their eggs are white and very similar to those of the California vul[illegible]ing about four and three-quarters by two and three-quarters inches.

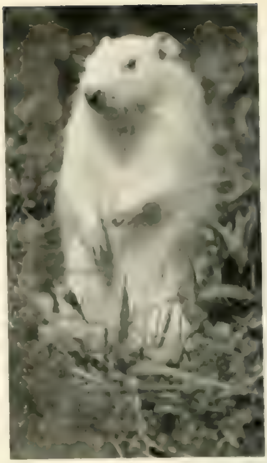
The young birds are clad in a soft brownish down for the first year and don't acquire full adult plumage until their third [illegible]

W[illegible] R. MILLIE.

Vallenar, Chile, S. A.







[illegible]

An unusual photograph taken by W. J. [illegible]

SIRS,

. . . As my entire family greatly enjoys your magazine, I think it well worth keeping in good order, which your binders make possible.

MARGARET ESTHER LOWENTHAL.

New York, N. Y.

. . .

[illegible]

. . . May I take this opportunity of saying how greatly your beautifully-produced magazine is appreciated by the members of the Ashmolean Natural History Society, in the capacity of librarian of which I have the pleasure of handling it?

[illegible]

University Museum,
Oxford, England

. . .

[illegible]

I rejoice in your beautiful magazine and find it a source of great value, diverting my mind from the halocaust in Europe. Through your articles on conchology, I have become interested in shells.

[illegible]

St. Paul, Minn.

. . .

SIRS:

. . . I enjoy NATURAL HISTORY so very much. It seems to become even more inter[illegible]

[illegible]

Georgia Teachers College,
Statesboro, Ga.

THE MUSEUM AND SCIENCE

THE history of life on the earth has been a record of the struggle of organisms to gain freedom from their environment. The rise of civilization has had the same basic motivation, a desire of people for real freedom.

Thomas Jefferson coupled freedom and science as conditions of progress. Every new discovery gives us added knowledge and a more precise orientation of ourselves to our universe. Science has been developed by man through the centuries to wrest an ever-increasing measure of order and security from the darkness and chaos about him. The giant Antaeus of Greek mythology was said to maintain his strength only by contact with Mother Earth. Civilization today is struggling to maintain its strength while weighted down by a complex superstructure of conflicting traditions and interests. We need to turn back to Mother Earth to regain perspective.

The Museum has always maintained research laboratories to discover Nature's truths and to demonstrate them to the public. Today fifteen scientific departments are hard at work. No less than 111 staff investigators and volunteers study the material gathered by our expeditions. As every corner of the globe becomes explored, our expeditions are returning to familiar places to study intensively with improved techniques the lives of the creatures there. Today we are concerned not so much with the rare or the exotic but with the dynamic factors which make individuals succeed under particular conditions.

We learn with the cortex of our brains, but our urge to get somewhere comes from the clenched fist or the instinctive part of our make-up. These instincts are very ancient, sometimes helpful but often harmful when misdirected. Even mother love can be detrimental when over- or under-emphasized. The Museum in recent years has sent expeditions to Polynesia, New Guinea and the East Indies to study the consequences of such maladjustments among primitive peoples. Further, it has maintained a modern laboratory where new techniques are brought to bear on the nature of our instincts. There is a chemistry of behavior, and some individuals, due to an inadequate environment or other misfortune, may be in serious need of new adjustments.

In animal societies the behavior of one individual may have a profound influence on the acts of all the others. Museum investigators interested in animal societies and in the laws regulating their behavior find that the supermind, the mind of the flock, has evolved in time and in accordance with natural laws. In these days of human mob action, these studies are particularly illuminating.

One of our major tasks is to investigate and recommend sound conservation methods. Natural science is not, however, a technique of conservation or a body of knowledge in regard to animal life. Rather it is an attitude of inquiry, observation and reasoning in regard to the world about us. As this science is reflected in our exhibition halls, so will the attitude of our youth be affected. It will train youth to observe, test and only then to theorize.

Progress in the world of tomorrow will be made not so much by changes in our bodily structure as by changes in our thinking. What happens in men's minds will determine what will happen in the world. The Museum, by bringing natural science, that is the truths of Nature, to the man in the street, is playing a major role in fashioning public opinion and aiding man's orderly and spiritual development.

G. Kingsley Noble

As NATURAL HISTORY Magazine goes to press, news of the untimely death on December ninth of Dr. G. Kingsley Noble, who wrote this editorial, brings the sharpest feeling of loss to the American Museum of Natural History and to the world of biology he so brilliantly served. His great work in exploring the frontiers of human knowledge and his vision to see beyond—both surpassing the measure of brief words—will persist through the years to come.

SAID THE ELECTRICAL MOUTH TO THE ELECTRICAL EAR . . .

"Joe took father's shoe bench out. She was waiting at my lawn."

If you were passing through the Bell Telephone Laboratories today you might hear an electrical mouth speaking this odd talk, or whistling a series of musical notes, to a telephone transmitter.

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This is only one of the many tests to which telephone equipment is subjected in the Bell Telephone Laboratories. And there is a reason for the selection of those particular words.

It happens that the sentence, "Joe took father's shoe bench out," and its more lyrical companion, "She was waiting at my lawn," contain all the fundamental sounds of the English language that contribute to the intensity of sound in speech.

Busily at work in the interest of every one who uses the telephone is one of the largest laboratories in the world. The development of the telephone in this country is proof of the value of this research. In times like these, the work of the Bell Telephone Laboratories is especially important.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME XLVII—No. 1 ★ ★ ★ ★ ★ ★ **JANUARY, 1941**

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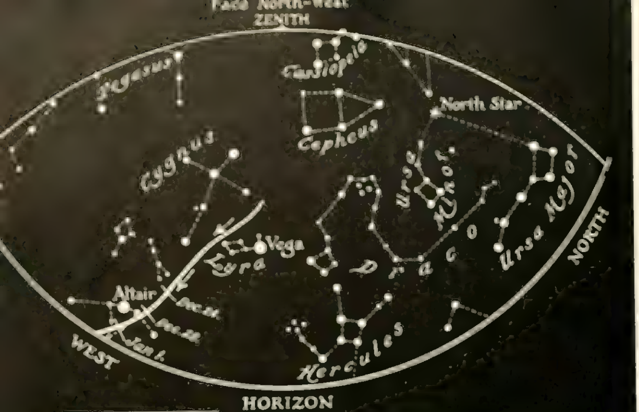
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Ursa Minor
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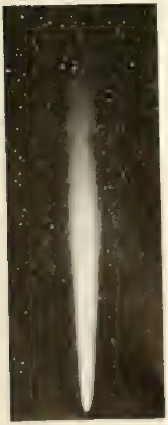
Vega
Lyra
Draco
Altair
Dec. 22
Dec. 28
Jan. 1
WEST
Hercules
HORIZON

TO FIND Cunningham's Comet, face the western and northern sky at 6:00 P. M. on January 1st, whereupon you will see the constellations as shown at left. Hold this sky chart in front of you and locate the Dipper, the North Star, and Cygnus, sometimes called the Northern Cross. Off the longer line of this cross, lies the bright star Altair, and nearby will stand the comet. Because it sets early, you must not wait long after sundown, and an unobstructed view of the skyline is necessary. The curved line shows the course of the comet, by dates. After January 11th, it will be a "morning star," as it were

APPROXIMATELY 1000 comets are known which return toward the earth at intervals ranging from a few years to a million years or more. Below is Morehouse's Comet, photographed against the moving background of stars

HALLEY'S COMET on May 12 and 15, 1910



A COMET IS HERE

The largest and brightest luminary of recent years spreads its glory in the western sky and recalls the dire portent which the ancients ascribed to these ghostly wanderers of space

By CLYDE FISHER

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FROM the time of earliest record, comets have been generally regarded as portents of evil; and they will always appeal to the human imagination because of their beauty and because some are the largest things in our solar system.

A comet was no doubt referred to in the Bible when "David . . . saw the Angel of the Lord stand between the earth and the heavens, having a drawn sword in his hand stretched out over Jerusalem"; and this was later interpreted by the historian Josephus as a forewarning of the destruction of Jerusalem.

When a comet appeared in 1681, a strange proclamation was issued in Switzerland admonishing all to remain in church for the sermon and to abstain from excessive carnival activities. Evening drinks were to be on a modest scale and to finish at nine, after which all were to go home quietly without shouting in the streets.

The comet of 1528 was described rather imaginatively by the father of French surgery, Ambroise Paré, as "so horrible, so frightful . . . that some died of fear and others fell sick." At the summit of it was seen the figure of a bent arm, holding in its hand a great sword, as if about to strike. On both sides of its rays, according to the eminent surgeon, "were seen a great number of axes, knives, blood-colored swords, among which were a great number of hideous human faces, with beards and bristling hair." A Greek word meaning "the long-haired one" is, indeed, the derivation of our word comet.

In this year we need no apparitions in the sky to remind us that all is not well on earth; and, in the light of modern science, we may give ourselves over to the pleasure of viewing one of the largest and brightest comets that have appeared in recent years with the assurance that any physical effects it will have on the earth will be quite negligible. Both scientists and laymen will watch this comet approach

(Below) DONATE'S COMET

From Harvard Annals

[illegible] to [illegible] with all the [illegible] [illegible]

Many will recall as I do the earnest desire with [illegible] first view of a comet. As a boy on a farm in the Middle West, I had the unusual privilege of using a good telescope of five and a half inch aperture. Through this I had seen planets, sun-spots, double-stars, star-clusters, nebulae, and the moon with its mountains and craters—but I had not seen a comet. Whenever the newspapers announced that a comet had been discovered, I would immediately write to the discoverer, or to some other astronomer, to tell him how very anxious I was to see a comet. I would ask the following questions, [illegible] for his reply so as not to take more of his valuable time than necessary: "In what constellation is the comet? Near what bright star is it located? About what magnitude is it? In what direction is it moving?" The telescope to which I had access was not equatorially mounted, so I could not take advantage of the astronomers' coordinates for location.

Although I must have tried for three or four years before I succeeded in finding a comet in this way, no astronomer was so busy that he failed to answer my eager, boyish letters. It was not for lack of their sympathetic help that I failed to locate one earlier. In the first place, no naked-eye comet came along during this period. And the telescopic ones usually moved too near the sun or too far away, or cloudy weather interfered and postponed my searching until my directions for locating so fast-moving an object as a comet were of no use.

Finally, however, I did locate a comet in this way, with the help of the late Dr. J. G. Porter, then Director of the University of Cincinnati Observatory. This one happened to be Encke's Comet, one of Jupiter's family of about 50 periodic comets. This inconspicuous comet has the shortest period of any comet known—about three and a third years.

One never forgets his first comet. After my first, which was telescopic, I was quite lucky to see five fairly bright naked-eye comets during the first dozen years of the present century, one of which many may be surprised to know was visible in the daytime, namely Comet 1910a.

Prominent feature of sky

No telescope will be needed to see the present comet, for it will be a conspicuous feature of the heavens. A typical comet consists of a head and a tail, which together occupy such an enormous space as almost to stagger the imagination. The statement made by a prominent astronomer about a century ago "that a comet could be packed in a portmanteau" is not true, but the scattered material composing a comet would, if brought together, probably form a mass ridiculously small in comparison with the comet as we see it. The head of every comet is believed to contain a nucleus consisting of a loose mass of separate, solid bodies of iron or stone, in all essential respects the same as meteorites. It is true that the nucleus is not always visible, even through a telescope, but this is thought to be due to its small size and great distance. The tail of a comet consists of extremely tenuous material that is forced out of the head by the radiation pressure of the sun.

We have had few naked-eye comets during the past 30 years. The one that is now in the sky promises to be exceptionally bright. This comet was discovered by photographs when it was much too faint to be seen with the unaided eye. The discovery plate was made on September 15th at the Oak Ridge Observatory of Harvard University, by Leland E. Cunningham. From the constellation Cygnus, popularly known as the Swan and sometimes as the Northern Cross, where it was discovered, this comet passed through the inconspicuous constellations of Vulpecula and Sagitta, and approximately on Christmas Day entered Aquila, the Eagle. On January 1st, it will be close to Altair—just a little way south of west of this first-magnitude star. By January 10th, it will have passed through Aquila into Sagittarius, the Archer. On January 11th, it will be in conjunction with the sun, after which date it will be a "morning star," as it were.

By January 19th, it will have reached its closest point to the sun (perihelion), when it will be about two-fifths as far from the sun as the earth, or about 36 million miles. At that time the tail will be millions of miles long. The longest tail of any comet on record was that of the Great Comet of 1843, which was nearly 200 million miles in length, considerably more than twice the distance of the earth to the sun. On account of the enormous size of the tail, occasionally a great comet is the largest body in the entire solar system, not excepting the sun.

When this new comet was discovered, it was more than 200 million miles from the sun, and at that time it had a sizable tail—one some 400,000 miles long, or almost twice the distance from the earth to the moon. As is the habit of comets' tails, it is expected to grow in length and size until the comet reaches its closest approach to the sun. At that time the head of the comet is expected to be as great as 100,000 miles in diameter, or more than ten times as thick through as the earth. Thus Cunningham's Comet, so named for its discoverer, promises to be the brightest and most striking one of these erratic wanderers that we have seen for 30 years and will be a spectacle which no one will want to miss.

How Dangerous Is the Jungle?

By C. SUYDAM CUTTING

Standing midway between the romancers and the debunkers, a world traveler and hunter makes illuminating observations on animal habits and gives shrewd pointers on how and how not to behave on safari

A GOOD way to improve one's knowledge of natural history is to look into some of the misconceptions that have arisen about the character of wild animals. For misconceptions, like bad pennies, keep cropping up in daily conversations, and our knowledge of animals must stand that test before we can go further. I refer not to wild animals seen along the length of a rifle barrel but wild animals as they exist under natural conditions. Our discussion will be limited to some simple observations, for I have never undertaken an exploring trip for the prime purpose of studying wildlife. But I have always been as much interested in the natural behavior of the wild animals I have hunted in Africa and Asia as in the actual sport.

For all the danger to the lesser animals, the jungle is a more tranquil spot that the romancers make out. The man who enters it for the first time may expect to see a congress of frenzied animals with a symphonic background of roaring lions, barking jackals, hissing snakes. Instead, he is surprised to find a vast silence, broken only by the cries of birds and the stridulations of insects. If he stays long enough, he may, depending on the region, hear a lion roar before starting off on a hunt, a hyena growling as if the sounds came from the depths of his bowels (the hyena's growl, contrary to legend, does not resemble laughter!), or a jackal barking his light, sharp note. Many animals will probably maintain a discreet silence.

The quietest time of all in the jungle is high noon, when the glare of the sun and the heat reach their greatest intensity. Most of the animals are probably sleeping. Even the birds and insects relapse into dead silence. Only the bees are inspired to greater noise and activity by the bright sunlight.

Late in the afternoon life begins to stir. Toward their various water holes, animals of all kinds begin their cautious descent. Whereas the ruminants want only a drink, the meat-eaters are yearning for dinner. The mortality curve rises at this hour.

The lion, tiger, or leopard will probably start his prowling toward the watering hole of lesser animals. The big cats are extremely agile but at the same time they are not in the market for any long distance runs. They first stalk their victims and then make a rush. When they get near enough to strike, it is all over for the victim.

TIGERS are hunted on elephant back or from a stationary tower. Dense cover and a dangerous, elusive quarry make it inadvisable to stalk on foot

[illegible] generally. The [illegible] from the [illegible] A [illegible] left for 24 hours in the jungle is likely to become carrion. And carrion is what the big cats like.

Now and then a big cat pounces on prey and misses. In this event he is usually disinclined to give chase. Racing through the jungle or across the open plain is not to his taste. If he bides his time he will find something later with less effort.

Offhand one would think that the habit of leaving game for the morrow's meal would result in thefts and hence lead to fights among the big cats themselves. But the instinct of these animals is usually to eat their own kills and let the property of others alone, and they usually lie up near their kills.

[illegible]

When the beasts have consumed their prey, the vultures take their turn. It has taken a great deal of observation to discover the secret spying methods of these birds. At the moment a beast makes a kill, the human eye is often unable to discover a single vulture either in the sky or in the surrounding trees. Yet within a few minutes scores, sometimes a hundred birds, come wheeling down from the sky, to fall on their game—what is left of the animal.

Their system is simple. Spaced far apart in the sky beyond the range of binoculars, they are able to survey a wide stretch of territory. If one detects something promising, he swoops lower to have a look. One bird sees another swooping down, and curiosity moves him to follow. The signal spreads for miles around. The sky patrol, too high for human vision, operates very efficiently.

With possibly the single exception of the leopard, big cats are not in the habit of killing more than they can eat. This acts as a sort of safeguard for the lesser animals, for all can tell the difference between a hungry cat and a sated one. Once when I was in a machan (a high platform in the trees from which one observes game), I heard a sambar deer get near enough to a tiger to bell at him. The tiger in the neighborhood of his latest kill seemed in no hurry to start feeding. This reassured the deer, who kept up his belling for quite some time and then moved off.

In discussing life in the jungle I have said that the danger for a man is vastly exaggerated. Others have said this before me, and some have gone far enough to say they preferred a jungle, from a safety standpoint, to Fifth Avenue, New York, in the rush hour. I wouldn't go that far.

If there were no other reason to fear most jungles, there would be malaria. There are also scorpions, centipedes, stinging ants, and wild bees.

In Kohima, Assam, a swarm of wild bees once appeared on a tennis court while I was in the middle of a game. My [illegible] peremptory tone, "Stand perfectly still! Don't budge!"

I obeyed, standing breathless for several seconds while the bees whizzed by only a short distance above. The queen was in the center, of course, and any gesture indicating danger to her might have brought the vast cloud closing in around our heads.

We have said a great deal to deflate the common, romantic idea of the jungle and the habits of wild beasts. But the fact remains that man-eating animals *do* exist. When lions, tigers, and leopards acquire a taste for man, they are terrible, relentless enemies. When a big cat shows a tendency to attack man, he is, of course, an abnormal animal, and it is often difficult to say with any degree of finality what [illegible] to become [illegible].

Many explanations have been given. A big cat, once wounded by a man, may develop an inclination to attack men without further provocation. By example [illegible] may be taught to become enemies of man. Aged or disabled cats that find difficulty in slaying other animals may take to attacking human beings. Cats that have tasted human flesh seem more dangerous than those that have not. Many are the theories and difficult are the proofs. Case histories of wild animals, it stands to reason, are difficult to procure.

A distinction should be made between animals in the jungle and animals that wander afield near human habitations. When one reads that 3000 people lost their lives to wild animals in India during a single year and that 1600 of these were tiger casualties, there seem to be grounds for the notion that the jungle is as dangerous as the romancers make out. Actually the figures prove no such thing. Few of the casualties occurred in the jungle. The miscreant beasts were prowling near villages, many doubtless bent on stealing domestic animals. Their encounters with man certainly altered their natures. It is impossible to say how many of the attacks were unprovoked.

Selous, the most famous of big game hunters, who was killed in the Great War, said, "Any man who invites the charge of a lion is an idiot."

Tigers have a better opportunity than lions for declining further acquaintance with man. Whereas a green hunter, starting off in real lion country with the proper guidance, feels reasonably sure that his chances are good to get a lion, the tiger hunter has no such assurance. He may, as a matter of fact, undertake many shooting trips and never see a single tiger. Bigger and stronger than the lion on the average, the tiger is also more elusive. He is never seen in large numbers. His habitat is dense jungle and high grass. All in all, man and tiger meet less frequently than man and lion.

The density and height of vegetation in the Asiatic tiger country defies a hunter's vision. If he is on foot, views of the tiger are momentary and require a quick shot with very little time for a careful aim. Facing a wounded tiger in a jungle is a truly hazardous position. For this reason tigers are shot from the back of an elephant or from a machan which is set 20 feet or more above the ground. Natives of the tiger and lion country erect thornbush palisades to protect their cattle.

What has been said of the tiger applies also to the craftier and more courageous leopard. The same land usually harbors both animals.

Two ruminants who can be very dangerous because of their size are the bison and water buffalo. These animals, if wounded, may charge a man.

I learned something about the water buffalo during a shoot with Theodore Roosevelt, Jr. We were stalking a large herd in a vast, open dry swamp in French Indo-China. Because there were no trees and the grass was too short, we had inadequate cover. The herd sighted us. Instead of moving away or stampeding, they turned and faced us, with their leader out in front. At that time we were shooting with a Frenchman named De Fosse who had lived in Indo-China for a long time and knew the habits of the water buffalo. Instantly he perceived danger. "If the leader makes for us," he said, "the whole herd will charge at us blindly. They have no purpose of their own, a mere blind impulse to follow the leader. All of us must fire at the leader."

We lifted our guns. We fired. Two animals fell. There was a breathless pause while we waited to see if there would be a charge. But the noise of the guns terrified the entire herd. They stampeded away from us.

In South India I had an experience with the bison, or gaur, of that country. Once a solitary bull was wounded and he escaped into the jungle. We had to follow him for more than a day before finishing him off. My companion on this pursuit was Randolph Morris, a coffee planter, with whom we were staying. He knew the habits of the bison, and it was under his direction that we moved forward with infinite care from tree to tree. Twigs, dry leaves, and clumps of earth were daubed with the bloody footprints of the wounded beast. The jungle interfered with our vision. While we could always follow the animal's path, we could not gauge his proximity. From time to time we threw stones into the dense thicket in order to locate him.

Hour after hour we followed the bloody track. Once we got within 50 yards of the animal. Morris had decided it would be too dangerous to invite the frontal attack of an animal weighing almost 2000 pounds. A way had to be found to divert its attention.

When we found ourselves in a tiny glade not far from the animal, Morris tossed a knife, hoping the enraged bison would charge it and give us an aim. He threw it too far. The knife landed in thick jungle out of our sight. But suddenly we heard a snort, a bellow. The 2000-pound beast was crashing through the jungle. Our native servants were terrified and clambered up the nearest trees. Just at this minute I looked up. An enormous red and black squirrel, four feet long, went springing from treetop to treetop with such speed that he seemed to be flying. Then there was silence once more.

This failure meant many more hours of stalking. It was not until the next morning, as a matter of fact, that the bison was brought down.

These instances prove but one thing, that the bison and water buffalo are disposed to charge, given sufficient provocation. The word "provocation" is important. These two ruminants, along with the big cats, have been taxed with a fundamentally hostile attitude toward man. But often it is man that starts the trouble.

Attack without provocation

I can name two animals, however, that will attack a man without provocation. They are the Asiatic sloth bear and the rhinoceros. Up to the moment no mitigating circumstances have been found for them. The king cobra is also supposed to attack without provocation. But on the whole, snakes are much maligned.

We have named three out-and-out aggressors. But this is not such a formidable list when we consider the legends of evil behavior in the animal kingdom.

In American folklore a great deal of mischief has been imputed to the wolf and the eagle. Let us consider the wolf's case. The United States Biological Survey disposes of two legends. American wolves do not hunt in large packs and they do not attack man. The most they achieve in the way of communal organization is the hunting of smaller game in small groups. Man they let alone. On the other side of the wolf ledger there are plenty of cases where [illegible] and [illegible]

[illegible] the eagle's [illegible] [illegible] [illegible] they will [illegible] rabbits, hares, and even young lambs. But eagles which seize children belong in mythology. Among the natives of northern Chinese Turkestan, incidentally, the eagle is sometimes used for coursing. The bird is let loose at gazelle. Left to his own choice, he would not ordinarily attack such a big animal since he could never hope to carry it back to his aerie. But he has been well trained. He knows that [illegible] in its flight, mounted sportsmen will soon ride up to dispatch it.

By this time it has become reasonably clear that in most conflicts between man and beast, man is the [illegible]—as a means of procuring food and for skins to protect his body against the elements. He has left a legacy of fear with the animals, and the fact that some of them when injured or menaced will fight back is not in the least surprising.

One curious phase of man's relation with the animals is the process of domestication. Although all the domestic animals we know today were originally wild, the transformations all took place in prehistoric times. There is no written record of any animal's being domesticated in modern times, except the African elephant. And whether we are to call the African elephant a domestic animal is a moot point.

We have seen that wild animals are inclined to flee from man. Certain animals enjoy special advantages, such as speed and cunning, in avoiding human contacts. Others are well protected because of their isolated habitats.

In my experience the most interesting kind of hunting is provided by the anoa of Celebes, the panda of Chinese Tibet, and the ibex of northern Ethiopia and of the Tien Shan Mountains of China.

Even to approach the Simen Mountains of Ethiopia or the Tien Shan range requires tremendous effort. Crags and precipices at lofty altitudes are the habitats of the goat. The chances are against the hunter's even seeing game, to say nothing of shooting.

The panda inhabits a mountainous region, dense with dwarf bamboo. Not only is visibility bad but the ground is usually covered with mud so that the hunter must constantly guard against falls. Silent stalking is out of the question: the bamboo cracks and breaks so that the panda is forewarned.

The anoa [illegible] of Celebes lives in steep, hilly country, protected by dense jungle. Merely to cut one's way through this jungle requires terrific labor. Thorns reach out to scratch the face and tear the clothes. Visibility is usually limited to a green wall a few feet away.

Tiger hunt

I should like to tell of a tiger hunt carried out in Nepal, in the district of Kheri. This hunt, to which I was invited by Kunwar Dillipat Shah, brother of the Maharani of Kheri, was interesting because it showed something of the tiger's characteristics and emphasizes the trait I have stressed—the desire of the big cats to avoid trouble.

The first step was to tether native cattle to trees in the jungle. The forest officer was aware of the approximate number of tigers in the district, having acquired the information from native forest rangers, who seemed to know everything going on in the jungle. When a tiger or leopard had made a kill, the facts were reported to us the next morning by the ranger. Preparations were immediately made for a hunt. The tiger or leopard, after killing a calf, would invariably drag it a short distance away, sample it, and then go away for a while. Until he felt disposed to return and finish his meal, he would in all likelihood remain in the vicinity of the kill.

There were two periods of the day when hunting was feasible. One was the early morning shortly before sunrise, when there was barely light to see one rifle sight. The other was in the heat of the day, when the animal would be lying in some thick, densely shaded spot and could be driven out by a line of elephants. The middle of the day was the better time because it gave us better visibility for shooting. (We hunted both tigers and leopards in exactly the same way.) It was not necessary to hurry, for we knew the tiger would probably be somewhere in the vicinity of his kill all day.

We had twelve elephants in the line, which gave us a beat of considerable breadth. The breadth varied so much depending on the nature of the terrain and the proximity of the tiger, that it was difficult to estimate its mean. Perhaps it was never less than 150 yards or more than 300.

The beat moved through high ratwa and nurtle grass, which sometimes grows as high as the howdah (the commodious railed, canopied seat on the elephant's back). Should a tiger sleeping in the grass be startled by our beat, his natural tendency would be to move on ahead of us. But cases have occurred where a tiger, driven out of his refuge, broke back through the line of elephants. Great precautions had to be taken to keep the elephants close enough together to frustrate any such move; for swinging around to shoot from an elephant's rear is difficult.

As long as we could drive the tigers in front of us we had no fear that they would disappear "into the blue" like deer or antelope. Tigers, like all big cats, will not run far. They have a short temper and no running endurance. It is true one may lose them, but the explanation then would be that they had turned or doubled and were again secreted in a spot where the beat would just miss them.

The tiger as a species was originally a cold weather animal. The Indian tigers of today are supposed to have descended from Korean, Manchurian, and Central Asiatic stocks. The reason for the migration seems to have been the more plentiful game afforded by the hot countries.

The tigers in our area were not fond of heat. As soon as the sun was fairly well up from the horizon, they chose a densely shaded spot wherein to lie down.

With twelve elephants in line, a considerable area could be covered; and since we continued beating as long as the light permitted, our chances for discovering a tiger were excellent. All during the beat the line tried to comb those places where the grass was highest and the jungle thickest.

This difficult and highly technical show was managed by the Kunwar with consummate ease. He used gestures. He spoke in a soft, gentle voice. Occasionally he whistled. Men and elephants were instantly responsive to his signals.

There were no dull moments during the hunt. We never knew when a tiger might appear. But we did know that a bad shot might cause the tiger to charge at an elephant and maul him. An elephant cannot abide the smell of a big cat. Seeing a tiger, he will always trumpet and raise his trunk and curl it over his head, for he knows how vulnerable he is to a tiger's claws. Because a tiger can leap very high, accidents do happen. However, keepers always take great care to dress their elephant's wounds.

Although we had twelve elephants we did not have a rifle on each. Three or four rifles among the lot was considered a fair number. Each of the elephants carrying a rifle also carried a howdah. The other elephants, merely assisting in the drive, each carried the *mahaut* (keeper) and one or more other natives.

The *mahaut* always sat forward of the elephant's shoulders. His knees were curved around the animal's ears, and his feet dangling downward gave the signal for every movement. The other natives sat on a large pad fastened to the elephant's back by ropes. These ropes provided them with a grip when the going was rough.

Shooting from a pad elephant is not uncommon. The hunter, sitting directly behind the *mahaut* and facing due forward, has two means of traversing his rifle, right and left. For general shooting, however, the howdah is preferable. This is a comfortable perch and is large enough to accommodate an extra kit of guns. For the sake of steadiness one usually stands up to shoot from a howdah. Hunters find it better to lean against the front rail for greater steadiness. Before any shooting is done, the elephant is brought to a halt, but even so there is apt to be some motion, for he may suddenly shift weight from one foot to another. Even his breathing may make the bead on the front sight a little wavy.

One morning word was received that two tigers had been spotted. One had made a kill the night before. We started off immediately. After an hour's beat we arrived at a dry swamp covered with nurtle grass. This grass was so high it covered the heads of all our elephants.

The morning was well advanced. It was very hot. The grass gave the tiger an excellent shelter against the sun. Advancing slowly, we roused many wild pig and hog deer from their noonday rest. Everyone was tense. Those with rifles were standing at the rails of the howdahs, staring straight ahead.

In a situation like this the first intimation that a tiger is near comes from the trumpeting of one or more elephants who have winded him. Although tigers and elephants are not natural enemies and usually leave each other alone, elephants, particularly females, are always afraid of tigers and, therefore, quick to sense their presence.

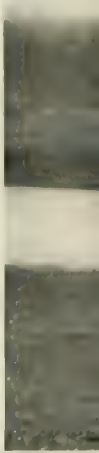
One of our elephants trumpeted. Soon after, we were able to locate our quarries. Their path could be traced by a ripple along the tops of the grass. Shooting was, of course, out of the question till the tigers could be driven out of the grass and into the bordering jungle where a proper view could be obtained.

The tigers advanced at first in a short series of slow movements. Then one of them broke to the left and passed safely beyond the elephant at the farther end of the line. No one saw it emerge from the grass. It was never seen again.

We concentrated on the other. Finally we saw him emerge at the end of the grass bordering on the jungle. One yellow-striped flash and he was gone. But we were sure he would not run far. If we were persistent in our driving, we would soon see him again.

It was slow work. The jungle vegetation, streaked with light and shade, made it difficult to pick out the tiger. But shortly before the light began to fade, we spotted him. A heavy rifle roared just once, and the tiger lay dead on the ground.

(Left) THREE VIEWS of a tiger hunt in northwest India showing the types of terrain where the striped one may lurk. Though tigers and elephants are not natural enemies, the latter cannot abide the smell of any big cat and usually give warning by trumpeting. Sometimes their keepers must dress gashes which the terrible claws of the high-leaping tigers leave even in the pachyderm's tough hide. The tiger is bigger and stronger than the lion, and more elusive. His nature is altered by encounters with humans near villages. Attracted by domestic flocks, he is thrown into conflict with their owners, and casualties are sure to follow. Thus it is in or near the pasture or plantation, not in the jungle, that he acquires his taste for man



(Above) THE HIMALAYAS: a view of their northern side where the author hunted mountain sheep. At top right, the author's camp in southern Tibet is shown, and *(below right)* his caravan traversing wild ass and gazelle country in the same region

All Photographs by the Author

[illegible] leopard. We would then [illegible] whatever they could. The game [illegible] included [illegible] deer, black buck, alligator, chital, hog deer, partridge, [illegible] We [illegible] when we were out after the big cats, for at such a time the sound of shooting might have frightened them away.

No one could say that comforts and conveniences were lacking on the hunt. We lived in large, firm tents. One pad elephant carrying our lunch always traveled along with us. Out in the open, in the bright sun, it was very hot, but with the jungle always at hand and clumps of trees about, one could easily find shady retreats in which to rest. Our luncheon hour varied greatly, because on the tiger or leopard days we never stopped till we had bagged the quarry or lost it for the day.

All in all our shooting trip netted two tigers, two leopards, and a crocodile, besides the smaller game already mentioned.

One last word about elephants. In our hunt they were so careful of their footwork, so indomitable in pushing through difficult spots of the terrain, that we were able to scour the tiger country quite thoroughly. Their bulk was an aid rather than a handicap in plunging through the jungle. Their great trunks tossed logs aside, pulled saplings up by the roots, and tore boughs from trees. In dealing with any impediment, their trunks showed almost manual dexterity. A sure and subtle understanding existed between every elephant and its *mahaut*. As a matter of fact, the *mahaut's* language is a special dialect incomprehensible to the layman.

In return for their services, the elephants were given particular care by their keepers. They required, for instance, one bath a day in order to keep their skins healthy. The bathing and scrubbing in the stream near the camp was a regular ritual. It was an engaging sight to watch the great beasts lie [illegible] and allow the natives to give them a thorough scrubbing. For a brush the natives usually used a [illegible] which was not too rough for the elephant's thick hide.

This tiger hunt belonged to an elaborate type that takes place at rare intervals. The average man in India does not possess twelve elephants; if he did, he would find more productive uses for them than tiger hunting.

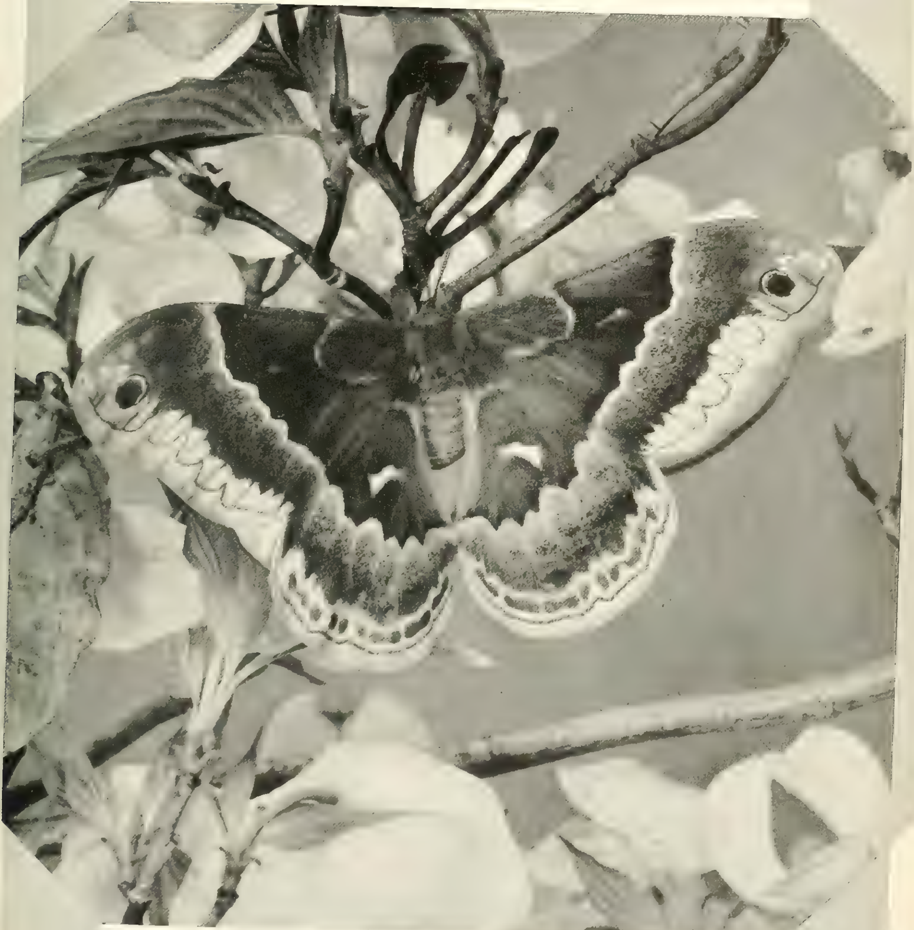
A tiger district, as I have indicated, is not precisely overpopulated with tigers. One does not hunt them in a random way as one might hunt deer. A machan is erected only when tigers are known to be in the immediate vicinity. If a tiger leaves a natural kill, the machan is put up nearby. If no natural kill has been discovered, a bait is provided in the form of a live domestic animal. In any case, when hunters climb into a machan they must be prepared for a long and tedious wait.

Machans are designed to provide a maximum of safety for the hunter. Tigers have been known to jump higher than fifteen feet, so the average machan is around 20 feet above the ground. Tigers, in common with other animals, seldom look up. They find nothing of interest in the skies and treetops. If their attention is drawn to the machan by the slightest noise, it is another story.

When man meets tiger, or for that matter any wild animal, it is usually man who takes the initiative.

MEASURING the head of a water buffalo taken in Indo-China. The water buffalo is one of the most belligerent of the ruminants. Given sufficient provocation, he will charge at top speed. But whether he is fundamentally hostile toward man is a debatable point

AN AMERICAN SILKWORM



A Story in Pictures by HENRY B. KANE

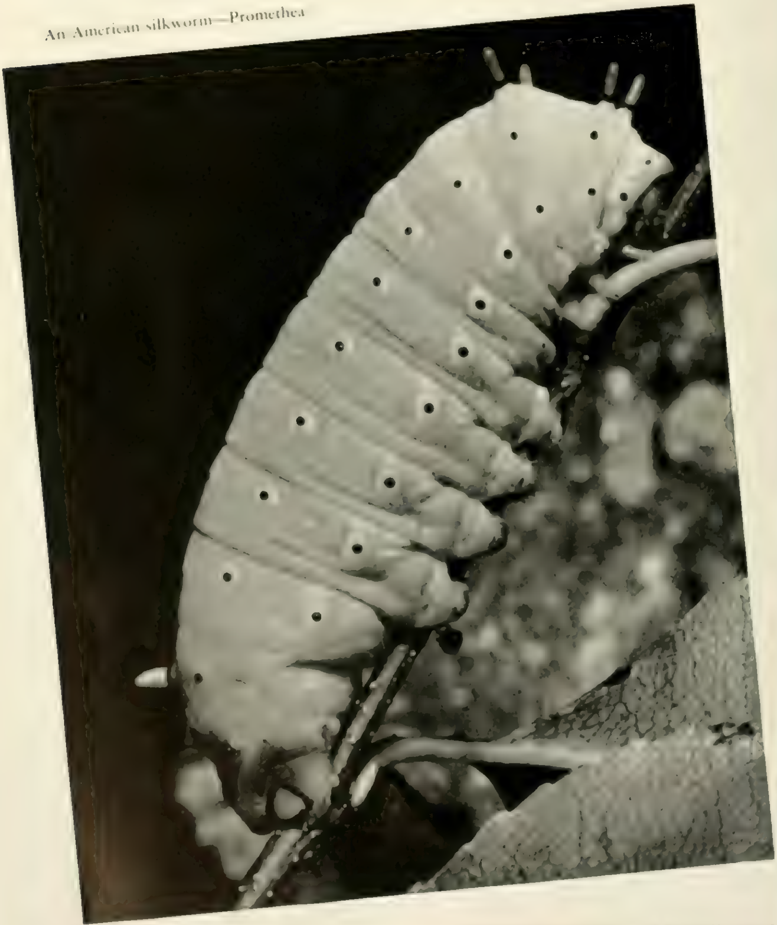
Millions of yards of silk produced annually by Nature in the United States prove that, if ever the need arises, we have scarcely begun to realize the full benefits of the insect world

THE SILKWORM OF COMMERCE is one of the two insects which man has domesticated, the other the bee. We commonly think of the silkworm as being essentially a Chinese insect, yet here in the United States we have a whole family of Giant Silkworms. Literally the woods are full of them, from the Atlantic to the Pacific.

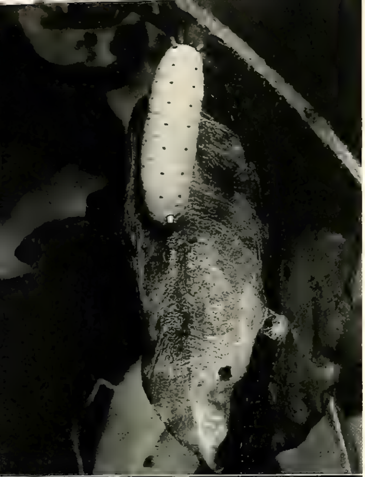
The silk spun by some of them is comparable in quality with that of the cultivated silkworm, though somewhat coarser. Various ill-fated attempts have been made to use it commercially. The main drawback is the high cost of labor. American labor cannot possibly compete with the peasants of Japan, China, Spain, and Italy.

The Giant Silkworms are caterpillars of our largest night-flying moths: Cecropia, Polyphemus, Luna, Cynthia, Promethea. The first two have the best silk; all have the same method of production. These remarkable photographs show a Promethea spinning its cocoon, a sight rarely seen, for although the caterpillar is large (two inches long) it is leaf-green and scarcely distinguishable from the foliage on which it feeds—cherry, ash, sycamore, and many others.

The caterpillar hatches from an egg, sheds its skin several times as it grows, finally reaches full size. After it ceases eating it looks for an acceptable leaf and spins a cocoon, wrapping the leaf about it. Inside it sheds its skin for the last time, becomes a pupa, emerges three weeks later (or if it is fall, the following spring) as a huge moth measuring up to four inches across the wings. Cecropia, our largest native moth, may measure about six inches across and is often mistaken for a bat at dusk.



An American silkworm—Promethea



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The leaf is covered with silk—

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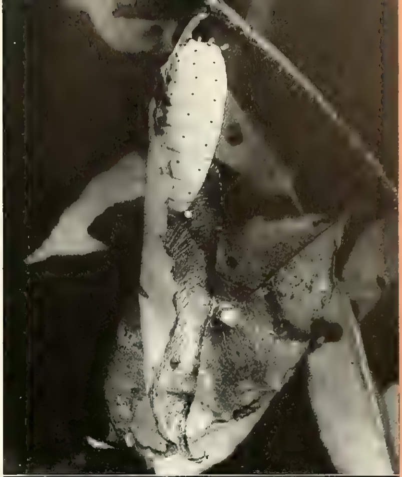
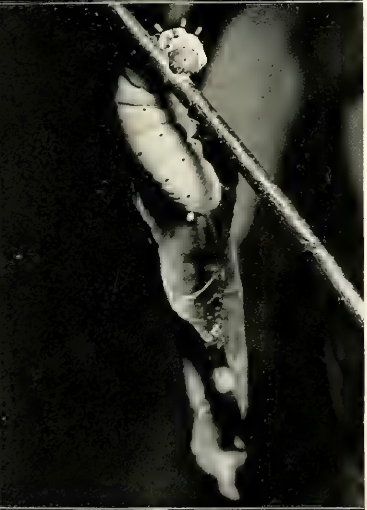
and starts to curl





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It is anchored to the twig—

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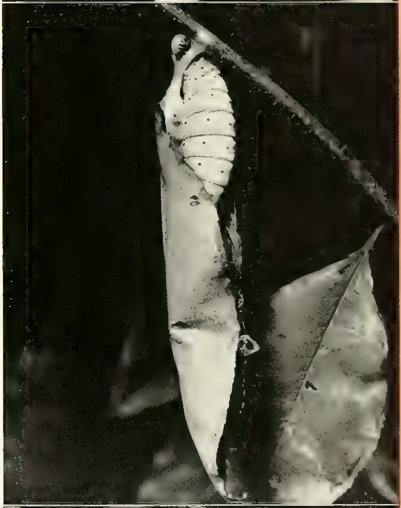
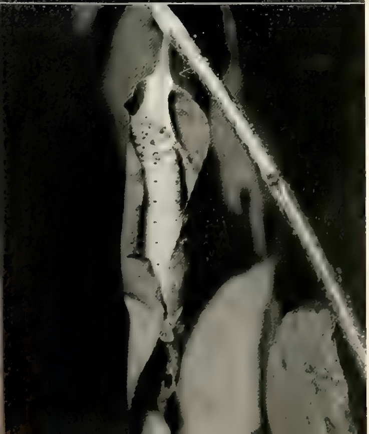
so winter winds can't blow it off





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The silk lining is thickened

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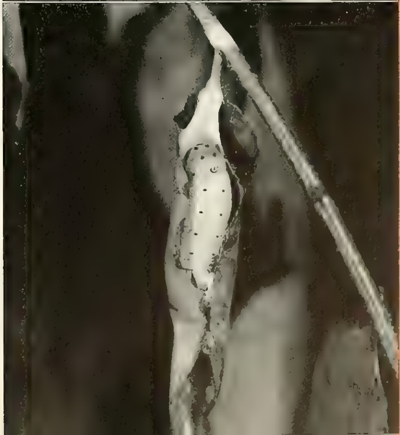
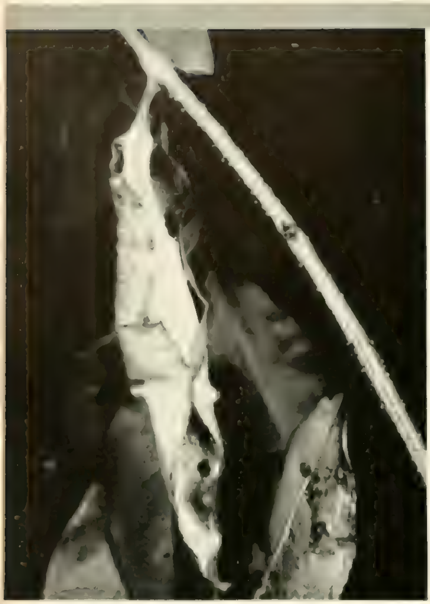
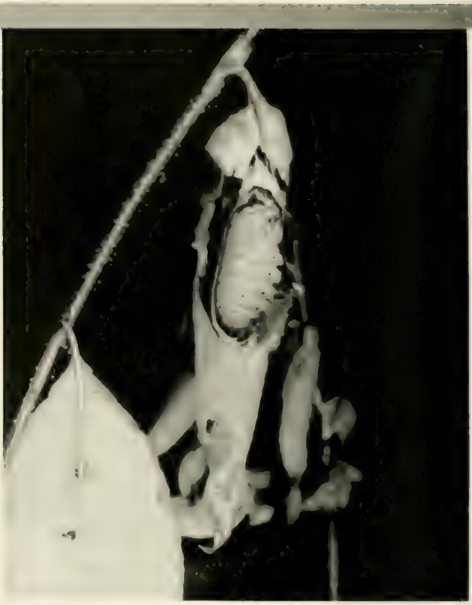
The silkworm closes up the bottom—



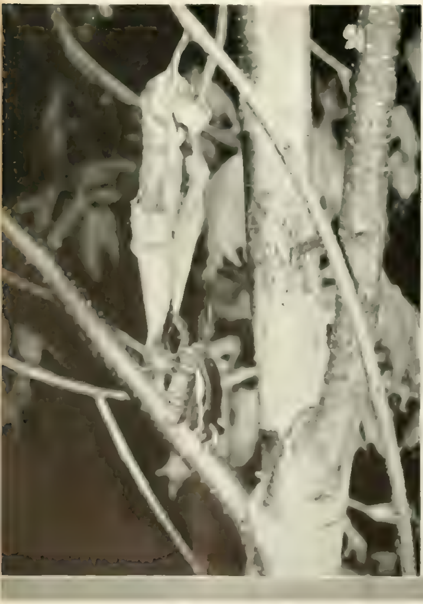


and the cocoon is completed

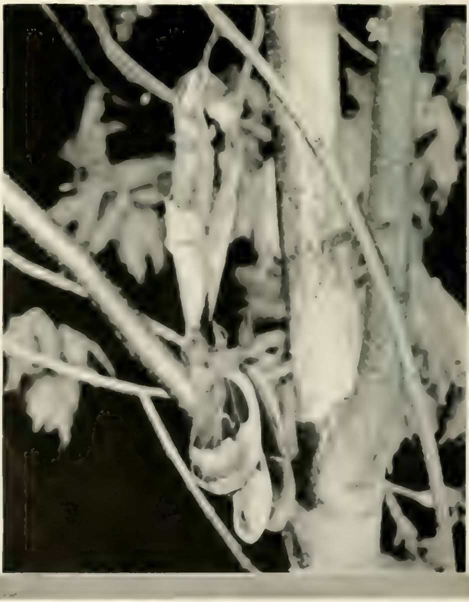


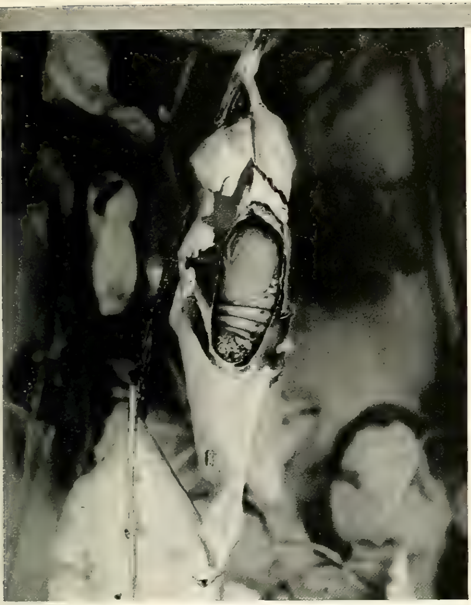
Body shrunken, it waits to shed its skin to become a pupa
(section of cocoon cut away)

In June the moth emerges, wings still unexpanded



The moth hangs here for an hour or so—



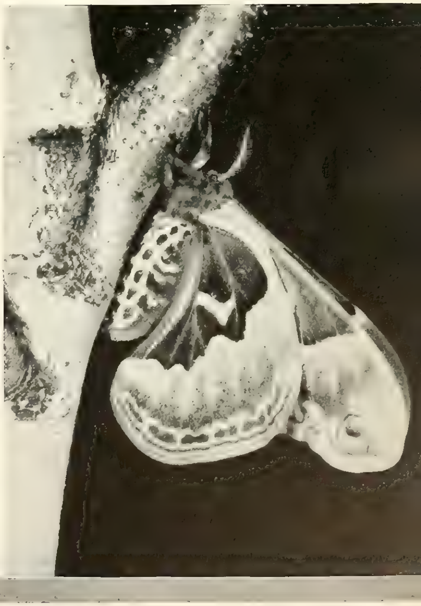


The pupa (Note discarded skin at bottom of cocoon)

Through the winter like dead leaves

and its wings grow big and strong

Promethea comes of age



ANTICOSTI

By WILLIAM MONYPENY NEWSOM

Two and one-half times the size of Rhode Island, Anticosti has remained a mystery to the public and a jynx to its long succession of private owners ever since Cartier discovered it in 1534

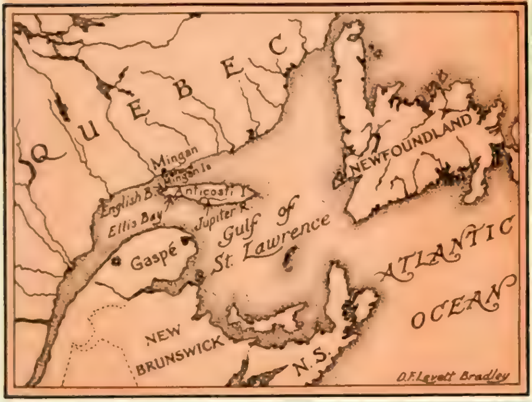


Photo by author

(Above) HIGHER THAN NIAGARA: the Vaureal River Falls. The scarcity of sound information on Anticosti's wildlife caused the author to visit the island for the American Museum

SCHOOL GEOGRAPHIES set forth the not very original information that an island is a body of land entirely surrounded by water. But in the case of Anticosti Island that description would be more vivid if it mentioned that this particular island always has been surrounded by shipwreck, disaster, bad luck, and misinformation, as well as water that is usually rough. At any rate, my first view of Anticosti was in this same geography. I was intrigued by it, as it seemed to me to resemble a colossal whale lying in the mouth of the Gulf of St. Lawrence, headed out toward Newfoundland, 150 miles away. But the geography's only comment was that it is 140 miles long, 35 miles wide, in latitude 49°-50° north, and in the island are to be found many bears. It was the latter comment that interested me most, of course, but it was years before I pieced together its history and went there to seek a personal interview with the bears.

It is well known that Jacques Cartier was credited with its original discovery in 1534 when he named it Ile d'Assumption, but even the famous Jacques could not make the name stick. Where the name Anticosti comes from is still a disputed point. Some think it was called Antecosta—"before the coast"—by early Basque fishermen. There are others who insist the name has an Indian derivation—"the place where you hunt bears." As to that, no one really knows.

During the century and a half after Cartier's visit, Anticosti has little history to record. It was, no doubt, visited by the Montagnais Indians from the North Shore, 21 miles away, who came there hunting bears or marten. This was a much easier crossing than the

45-mile run from the Gaspé on the south, and the North Shore Indians used it quite extensively. Then, in 1680, Louis XIV of France granted the island as a *seigneurie* to Louis Jolliet, who had explored the Hudson's Bay country and who, with Père Marquette, had also explored the Mississippi River. Since 1680 the island has always been privately owned.

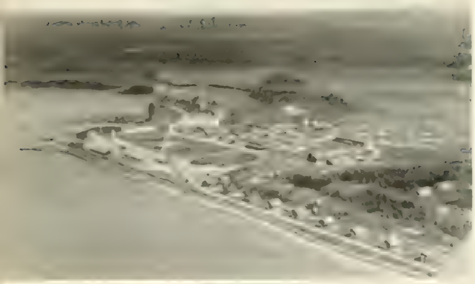
For ten years Jolliet did a thriving business trading with the Indians of the North Shore. He wintered at Anticosti twice. Then, Frontenac, the French governor at Quebec, who had been making a number of raids on the English settlements, became such a nuisance that Sir William Phipps decided to attack Quebec. Setting out from Boston with a fleet of 35 warships and 2000 men, Sir William stopped along the way to burn a few French settlements—and stopped at Anticosti. Unfortunately for Jolliet, his little settlement, probably at Ellis Bay on the west end of the island, was a mark for Sir William's vengeance, as he completely demolished it. A bit later Sir William encountered Jolliet himself, and being well known to Sir William, Jolliet and his wife and family were taken along as prisoners. However, Sir William's luck did not hold long after he touched Anticosti, for at the mouth of the St. Lawrence he encountered a hurricane that dispersed his entire fleet. By a bit of poetic justice, one of the frigates with 67 men in the crew was wrecked on Anticosti. During the winter that followed the crew had a very bad time of it, and a number of the men died from lack of equipment and poor food. In the spring, a small boat was sent south to secure help. After an arduous 44-day journey it reached Boston. Finally, the relief ship arrived, but only 22 men out of 67 who landed in Anticosti lived through this adventure to reach Boston.

Jolliet, however, was later released and returned to the island, but seems to have lost heart and done nothing further about it. He died in 1700, but as far as I have been able to learn, no one knows exactly what happened to him or where he is buried, though it may be on one of the Mingan Islands, or perhaps on Anticosti itself. After his death his several heirs also entirely lost interest in it. These heirs sold out a few years later to parties who had various schemes to colonize the island. There is no record of exactly why the colonies failed, as they most certainly did, but one list of supplies sent to the colonists gives us a clue. This list included six quarts of violin strings, a large number of coffin handles, harness buckles, iron boot heels, carriage steps, English saddles, and a printing outfit. This, I suppose, came under the head of winter supplies, though it is not specifically mentioned.

In 1874 the Forsyth Company was formed to make another attempt to colonize the island. Colonists from Newfoundland were landed, but they fared no better than the others before them. This time the Canadian Government came forward to rescue the colonists to save them from starvation. Then about 1884, an optimist named T. W. Stockwell bought the island—which is two and one-half times as large as Rhode Island—at sheriff's sale, and turned it over to a speculative outfit known as "The Governor and Company of the Island of Anticosti." More bad luck. They promptly went broke, and the trustees of this company sold the island in 1895 for $125,000 to Henri Menier of France.

When Menier arrived, it was a happy day for Anticosti, for he was one of the richest men in France, proprietor of Menier's Chocolate. He not only had very large ideas but plenty of resources to carry them out. First, he was a sportsman interested in shooting and fishing—but more particularly bear hunting and salmon fishing—and he proposed to make this island a huge game preserve. He also had ideas of developing the island and its resources. So he arrived at English Bay (now Baie Ste. Claire), where there was a small settlement of fishermen and trappers on the west end of the island. He came in his 1000-ton steam barkentine yacht *Bachante* with 75 men in the crew and established headquarters here.

In 1898, however, Menier decided to move his headquarters to another harbor some nine or ten miles from English Bay. Accordingly he built Port Menier with its houses, church, school, stores and workshops, and connected the two villages with a good road. He cleared many hundred acres for farm land—which incidentally has never been productive,


Port Menier. It was built in the days of high-priced pulp, but few of its houses are now occupied

A lighthouse on the North Shore cliffs: a peaceful view of a coast rich in the romance of history

[illegible]. And during this time he had his own freighter, the Savoy, with 18 men in the crew, running from Anticosti to Quebec for supplies. Menier spent the summers from June to September at Anticosti, living on the yacht a good part of the time—with telephone connection to shore.

About 1903 he started building the Villa, which was not finished until 1906. It is quite unique. The huge, imposing fireplace in the drawing room was designed by a French artist, while over it is a large Scandinavian wood carving of the sixteenth century. The black oak table and carved chairs to match are of Louis XIII period, and the four Flanders tapestries on the walls date from the sixteenth century. There is also a huge camel hair rug said to be of Arabic origin, and five water colors dated 1830 and signed by the French artist Gavarni. Around the top of the room are a dozen or so very dignified stag heads mounted in the European style. Here and there are other sporting trophies. In spite of this heterogeneous collection of treasures, the whole Villa was livable and attractive. Not the least interesting item in the Villa is the secret stairway. Only fifteen inches wide, it led from the rear of a clothes closet in Monsieur Menier's suite on the ground floor to a closet in the guest suite upstairs. None of his old retainers who knew him for years either could or would tell me who it was who occupied that upstairs suite.

From all of this it is evident that Henri Menier was a lavish spender. But his spending had a practical side to it that is not apparent in his villas and his yachts. He wanted to develop Anticosti commercially, not only to help the 250 inhabitants but to make the island pay for itself. It was for this reason he had the land cleared for farming. Also he decided to raise cattle and other livestock. Both ventures failed. Menier blamed the failure of the cattle on the dogs of the island, which he said had worms. Accordingly, in 1900, he had every dog on the island either destroyed or deported—so there are no dogs there now. But still, for some strange reason, neither cattle nor sheep will thrive on the island, although pigs do well enough. While he was struggling with the farming, he built a dozen miles of railroad to take out pulpwood. But here again he was not too successful. Because he feared that forest fires would destroy the pulpwood, he would let no one on the island smoke or carry matches, strangers were strictly forbidden to land there, and those who had permits were always searched for matches.

As to Henri Menier himself, there are conflicting accounts. But his old foreman, Tancrede Girard, and

Landing the seal on a typical St. Lawrence beach

Gray seals sometimes attain nine feet in length

Hunting for seal. Note long gaff needed to retrieve the sunken animal after it has been shot

Photos by author

Hauling the rare gray seal aboard. These seals often weigh 600 pounds or more

his personal guide and game warden, Bernard Le Jeunne, who were with him for 30 years or more, both agree. They tell me he was determined, resourceful, democratic, but inclined to fits of anger, not to say unreasonable rage. When some little thing displeased him, he would burst into a torrent of language, calling them all "animals." Yet while he was severe with the individuals, he considered all the inhabitants as his children and he was most generous in looking after their welfare. One of his most drastic rules was one prohibiting anyone from molesting game, and it went hard with those who were found poaching.

When Menier bought the island, intending to make it a game preserve, there were bears and foxes but no deer or other big game. Menier then stocked the island with deer, buffalo, wapiti and moose. The buffalo soon died and the elk did not thrive, there being but three or four old cows on the island today. Moose are present but not plentiful. The deer, however, multiplied beyond all expectations. Menier enjoyed shooting these, along with ducks, gulls, cormorants, bears and seals. He also was a keen salmon fisherman, but his greatest interest was in bear hunting.

I had, of course, heard of Menier's enthusiasm for hunting bear. At one time he had eight ordinary hounds and two big rough-coated staghounds on the island. I had also heard the rumor that he had a rocking chair mounted on a flatcar and he would cruise up and down the few miles of track, shooting bear from the rocking chair. As the story intrigued me, I decided to ask Bernard Le Jeunne, his chief guide for bear.

Bernard is old now, and his hair is white. His little eyes twinkle in friendly fashion, and one small drink starts a most abundant flow of conversation, all of it with appropriate gestures. Bernard's father was a hunter and fisherman of Scotch parentage who was born in New Brunswick. While Bernard speaks very broken English, he insists on calling himself Barney Young, although everyone else calls him Bernard Le Jeunne. So one evening when we were discussing the earlier days of the island I asked Bernard: "Is it true, Barney, that Monsieur Menier had a rocking chair on a flatcar and that he used to sit in the rocking chair and shoot bears from it?"

Instantly Bernard was on the defensive at the insult to Menier. He stiffened in his chair, then arose and held his right hand aloft.

"Ah, Monsieur," he said solemnly, "I hold up my hand and I swear to you that is the great libel. It is *not* true, Monsieur—he would nevaire do such. I

Sportsman's lean-to back in the game country

Anticosti still has bears. *(Below)* Flensing bear hide

Photos by author

deny, Monsieur, that the rocking chair was on the flatcar. Non. The rocking chair she was out on the [illegible] for the bear. It was there, Monsieur Menier shoots at the bear—not from the flatcar at all.

"But did you get the bear?" I asked innocently.

"Ah, as to that—it was quite an evening, Monsieur. You see, Monsieur Menier he have a very old bulldog name Jack he have a long time and he love him. But Jack he have no teeth and cannot walk far. So Monsieur Menier have me put Jack in the basket and carry him and we go to the bait for bear. Then Monsieur Menier put the basket down by him in the rocking chair.

" 'Barney,' he say, little whispering, 'it is, I think, better Jack die hunting the bear.'

"Just then I feel something at my back. 'Monsieur Menier,' I whisper, 'there is the bear at my back.'

" 'Don't stir,' Monsieur Menier he say to me.

" 'But, Monsieur, she is biting my back,' I say.

" 'Don't stir, Barney,' say Monsieur Menier. 'You will disturb the bear.'

"Then the old bulldog she smell the bear and she come to life. He bark. He jump this way. He jump that way. In fact, Monsieur, old Jack she just raise the hell. And then Monsieur Menier he see the bear and he raise up out of the rocking chair and—what you think?"

"What?" said I breathlessly, expecting the bear to fall dead upon me. "Did he shoot the bear?"

"No, Monsieur," said Bernard sadly. "The dog she bark again and the bear she run away."

So much for that rocking chair.

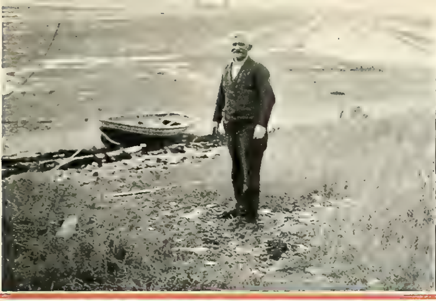
Bernard, with nearly all the other inhabitants, except the lighthouse keepers, was on Menier's pay roll by the year. But there was one man on the island who was not on the pay roll and Menier could not get rid of him. He was a squatter named McDonald, who had a cabin on the beach when Menier bought the property, at what is now called McDonald River, halfway down the north side of the island. McDonald was said to be a huge man six feet six inches tall, weighing 240 pounds, who lived alone and refused all company. For many years he lived there. Then one winter they found him dead. He had been dead a month before he was found, and the mice had eaten his nose. His diary showed he had taken some sable skins. These were never found, and to this day people are still speculating as to what happened to that valuable fur.

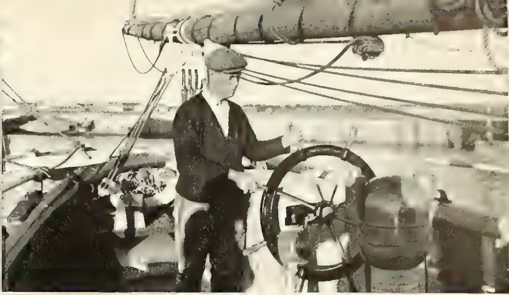
In 1913 or 1914, Henri Menier died, and left the island to his brother, Senator Gaston Menier. According to all accounts, Gaston was never as much interested in the island as Henri had been, and he spent only a month each year there. He still kept it as a game preserve until he sold it to the Anticosti Corporation for the equivalent of six million dollars. Gaston, however, reserved the salmon fishing rights on the Jupiter River for himself for ten years. When he left the island, he gave each of the old retainers a sum of money ranging from $100 or $200 to $1000. Girard, who held a responsible position, told me that he himself received $1000 and that about 20 men received a bonus.

For several years after the Corporation took over the island it tried in vain to break Anticosti's hoodoo. Pulp operations started on a huge scale. Port Menier's population increased to over 4000 inhabitants, and hundreds of thousands of dollars were squandered on loading docks, machinery and equipment. But in the end, the old jynx of Anticosti won out, pulp operations ceased, and the company merged into the Consolidated Paper Corporation, Ltd., the present owners. Realizing the pulp situation is hopeless, the new owners set about developing other assets, such as fox farming and salmon fishing for sportsmen.

So many salmon fishermen have been to Anticosti that I thought, when I planned a trip there for the American Museum, that there would be no trouble to learn from them all about the mammal life to be found there. But here again the mystery surrounding this island was apparent. The Museum had no specimens from Anticosti, except two old, black bear skulls that came by way of the Bronx Zoo. There was no reference to Anticosti in the Museum Library, and the salmon fishermen either had no information or told me fairy tales of seeing little red squirrels, when actually no squirrel of any kind has ever been known on Anticosti. Then one, who claimed to be an "authority" on all things Anticostian, told me the deer are very small, and that a "good buck would weigh 90 or 100 pounds live weight." Actually, the deer of Anticosti are normal size—the first buck I took weighing 240 pounds. Also in this strange tangle of tales I found a record of a new variety of marten with white-tipped feet, as well as several records of a new bear that had never been described—both of these stories turned out to be pure myths. I was also told we would find along the coast the ordinary small harbor seal. We found, in addition, the comparatively rare gray seal, locally called the "horsehead," that attains a length of nine feet and weighs upward of 600 pounds. So, little by little the mystery island, closed for so long by Menier, is giving up its secrets.

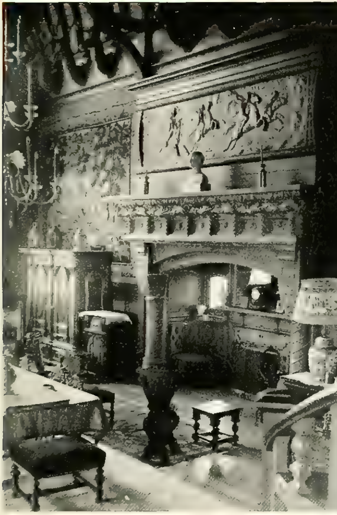
As to its future, it is anyone's guess what the price of pulp will do for it. Eventually Anticosti will probably go into the hands of the Canadian Government where it should be, commanding as it does the gateway to all of Canada via the St. Lawrence River. But, in the meanwhile, it is the salmon fisherman's paradise.





Photos by author

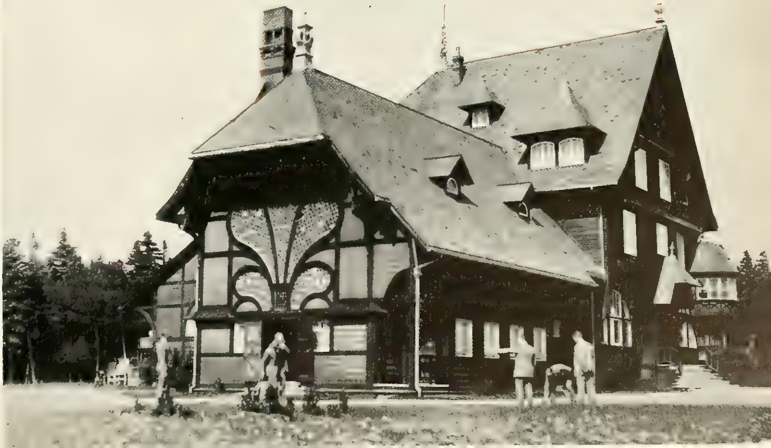
MOST BIZARRE chapter in Anticosti's unique history was the valiant attempt of Chocolate King Henri Menier *(center inset)* to turn it into a vast, private game preserve and develop its resources. He bought the large island in 1895 for $125,000, pouring several times that sum into such oddly assorted imports as buffalo herds, deer, which multiplied beyond all expectations, twelve miles of railroad, and the Villa shown below. Farming and cattle-raising both failed. Though crotchety at times, Menier was socially responsible, and the inhabitants loved him well. Two surviving retainers, Bernard Le Jeunne ***(top left)*** and Tancrede Giraud ***(top right)*** both received bonuses at his death



THE DRAWING ROOM is a veritable museum of European antiques

(Below) MENIER'S VILLA reflected the traditional eccentricities of a feudal-minded millionaire, even to the point of a secret stairway. Menier lived here only in summer

Photos courtesy of Consolidated Paper Corp., Ltd.



GEM FOR JANUARY

The mystic radiance of your birthstone, the blood-red garnet, symbolizes all the power and charm which the ancients attributed to it

The First of a Series By Frederick H. Pough

[illegible]

B[illegible] worn unwillingly and internally, for the superstitious Hanzas fired at the soldiers, using garnets as bullets. But garnets usually are regarded as stones of good omen, bringing calm and removing anger and discord when worn as charms. Other legends attribute healing powers to them, though this myth can scarcely have led to their use as missiles.

The concept of natal stones is an old one, having its roots in ancient times, perhaps even before recorded history. The breastplate of the high priest mentioned in the Old Testament contained twelve stones which were related to the twelve tribes and to the months. Originally it was thought that the wearing of a different stone each month assured good fortune. Later, possibly in the early eighteenth century in Poland, the idea was developed of a natal stone to be worn by each person according to his birth month, with the purpose of bringing him good fortune. Today's birthstones are a modernization of the stones of the breastplate, interpreted to the best of our ability from the scanty description extant, from our knowledge of the geology of the Mediterranean region, and from the gems we find in excavations. In 1912, the National Association of Jewelers adopted an official list which is today generally accepted, giving the birthstones and some alternates for each month of the year.

Garnet is the stone for January. The gem which the jeweler recognizes is only the deep red of the almandine or the pyrope garnet. While the mineralogist recognizes many other gems as members of this large group—the rich brown of the essonite, the violet of rhodolite, and the brilliant green of the demantoid—the jeweler justifiably does not include these as January birthstones. Justifiably because the ancients depended upon color for their classification, including ruby, spinel, and garnet under the general term, carbuncle. We thus have almost complete latitude in our choice. In fact, we may consider any of the garnet group as our birthstone, if we do not like the rich, deep reds of the pyrope.

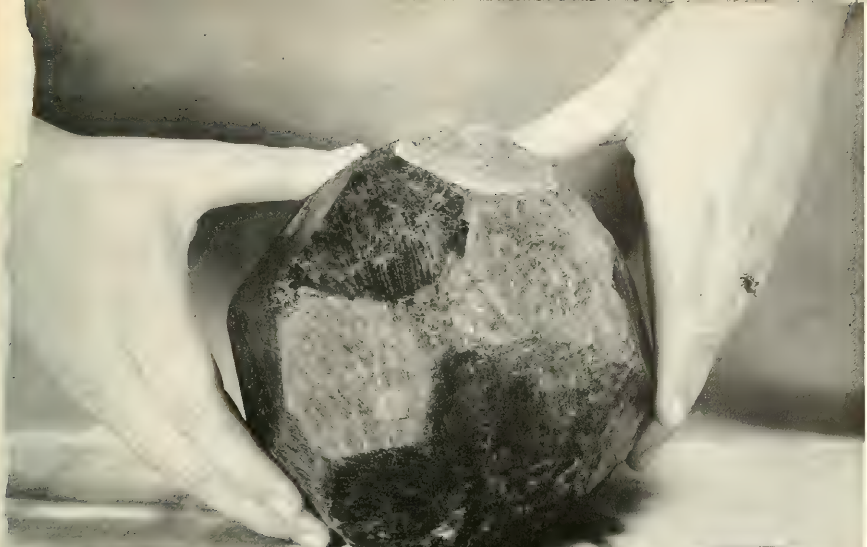
Garnets are among the commonest gems. They form, mineralogically, a large group of silicate minerals—some with calcium and aluminum; some with manganese, magnesium or iron, and aluminum; calcium and iron; calcium, magnesium, and iron; or calcium and chromium. They are hard, have attractive colors, and are often in clear, twelve-faced crystals, eminently suitable for gem use. Consequently, we find them extensively used. Bohemian jewelry, with its pavements of pyropes, displays some of the best known garnet work. The Bohemian stones are found as loose, waterworn pebbles in layers where they have been concentrated after washing out of a bed of basaltic rock. Garnets are often found in the United States. Anthills in the Southwest yield small garnet pebbles which are "mined" by the ants and dumped on the surface out of the way of their tunnels. A light violet variety is sometimes found in North Carolina and is known as rhodolite; if it were more abundant it would be a popular gem.

Garnets are frequently cut in faceted shapes, but they are generally so dark that a back is necessary to give them any fire. Such stones are cut in a convex form, known as cabochon, with the bottom slightly hollowed out to make less thickness and greater transparency. Engravings on large garnets are frequent, and beautiful examples are sometimes seen. The collection of the American Museum includes, among other pieces, a small bowl cut from a garnet.

Cabochon-cut garnets are known today as carbuncles, an ancient name derived from the Latin *carbo*, coal, and referring to the internal fire-like color and reflections of garnets. But the ancients could not differentiate among the red stones; and today we find it difficult to be sure exactly which gem was meant in some of the old legends in which the stone was called simply carbuncle.

Innumerable legends are associated with the garnet, many of them referring to a fancied luminescence. The Talmud relates that Noah's Ark was illuminated by the light of a single large cabochon. Many other stories associate it with snakes and serpents. Possibly the redness of the eye or mouth fostered the tale that the reptiles carry a light in the forehead or mouth. When the snake occasionally dropped the stone to look at it, an intrepid warrior could dash up and cover the stone with mud or a cloak; whereupon the poor animal, no longer able to find it, would finally wander away to die of grief or commit suicide. The association of carbuncles and serpents is a legend which repeatedly crops up in apparently unrelated places. Even our Cherokee Indians have a tale of a snake carrying a luminous carbuncle in its forehead. This "light" was stolen by a warrior and displayed on special occasions, being accorded great religious awe.

Garnets possess other mystic qualities, often seemingly at variance with one another. The blood-red color has been thought to be symbolic of Christ's sacrifice. The Koran's fourth heaven is built of carbuncle. An Arabian dream book says that any monarch who saw a garnet in his sleep would have great joy and good fortune, and would be more feared by his enemies than before. Today a garnet is still supposed by the credulous to preserve some of its ancient efficacy, from the day when it was supposed to give or preserve health, keep off the plague, reconcile differences between friends, increase riches and honors, to serve as an emblem of constancy, and, when worn around the neck, to keep off thunder.

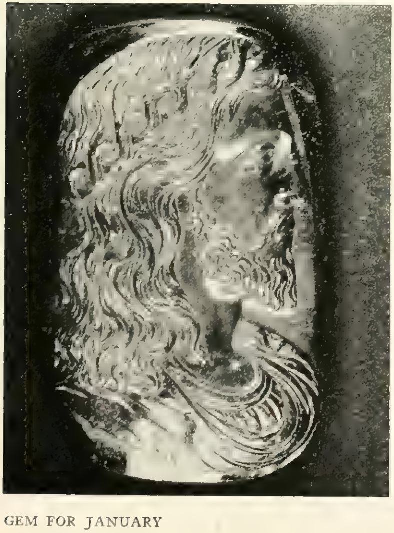


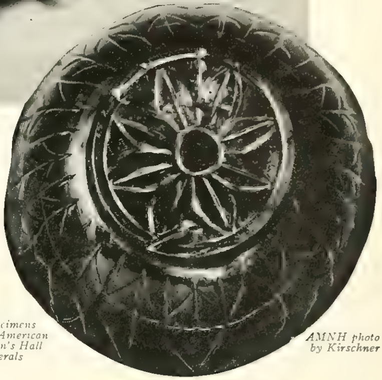
THIS massive ten-pound garnet enjoys none of the traditional romance associated with historic gems, but it boasts the unique distinction of having been found within a stone's throw of Macy's Department Store, in the heart of New York City. Though usually red, garnets are also rich brown, violet, and brilliant green.

(From N. Y. Mineralogical Club Collection)

(Below) A beautifully engraved garnet, originally in the Vatican Collection

AMNH photos by Coles



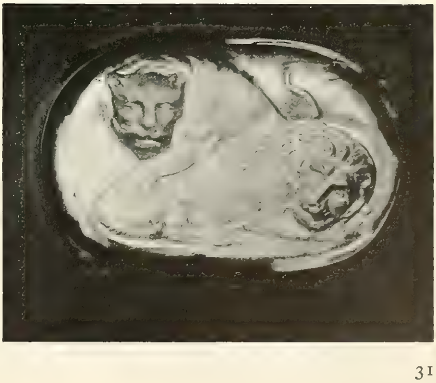


All specimens in the American Museum's Hall of Minerals

AMNH photo by Kirschner

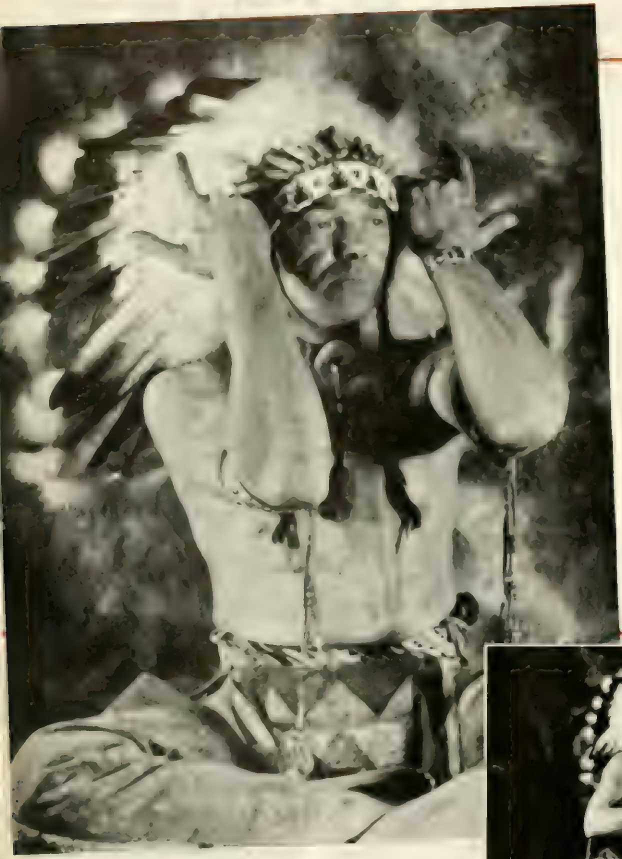
(Above) An old Hindu bowl of garnet

(Below) TWO LIONS. Concave cameo from Burma



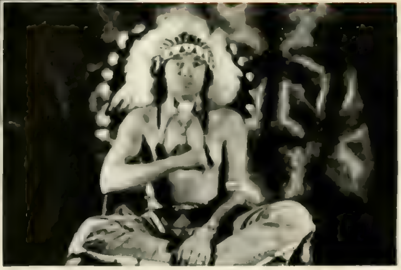
TALK-WITHOUT-TALK

[illegible]



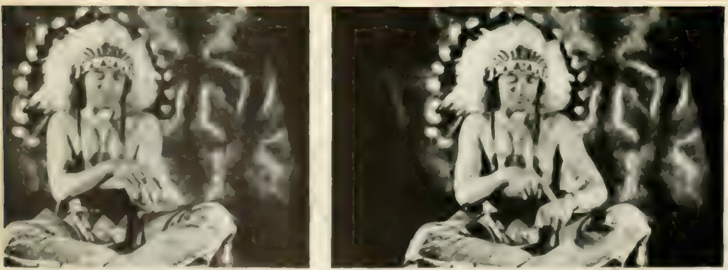
The picturesque clarity of the American Indian's sign language is shown by the gesture-word for "buffalo" *(at left)*, the animal which, more than any other force in the life of the Indians, necessitated the development of the universal language of the Plains. The extended thumbs, representing the ears, wiggle; and the forefingers, indicating the horns, may be omitted entirely to symbolize a calf

Below are shown a series of signs illustrating how the various parts of speech can be represented in the sign language

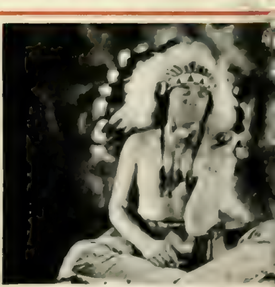


PRONOUN: "I" Expressed by the simple gesture of touching the thumb to the chest

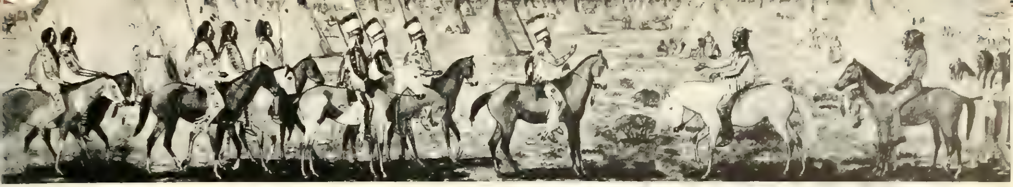
ADJECTIVE:



NOUN: "OJIBWAY" Two signs are needed to express this proper noun. The first shows a soft, puckered moccasin; the second, with a rubbing motion, denotes red skin



ADVERB: "TIMIDLY" The raise
"man,"
like a co



From a mural in the American Museum by the well-known Indian artist, E. W. Deming

THE INDIAN'S GREATEST INVENTION

The American Indian's greatest invention was the sign language. By a system of several hundred signs, representing all the parts of speech, the Indians of the Plains conversed together with a flow of motions which equaled the articulatory dignity of spoken speech. Nowhere else in the primitive world was such a system of talk-without-talk even approached.

The old Indians laugh when they tell the story of how an early white man observed Indians using the sign language and thought that they were childlike persons incapable of full, normal speech. Actually the white man was witnessing the most marvelous gesture-development found in any continent, a method of communication comparable to the invention of the Chinese ideographs of the Orient. Further than that, the Indians were using what was to them virtually a universal language—the potential value of which we can easily see in our modern polyglot world.

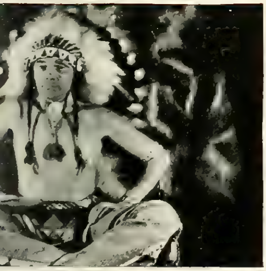
When the Indians of the Plains hunted the bison over a large area, fifteen or 20 tribes speaking different languages were brought into contact with one another. Unable to converse in any other way, they developed the use of signs, and in time perfected this marvelous language. The American Indian sign language attained a vocabulary and complexity at least 20 times as great, and by some standards 100 times as great, as any other comparable system elsewhere in the primitive world.

All who have studied the sign language of the Indians have marveled at the eloquence and strength with which its few hundred signs can express almost any message that the speaker wishes to convey. The American Indian sign language has given romance to the study of the American Indian. It has also thrown light on the grammar and fundamental concepts of the Indians' spoken word. More than this, the sign language has been one of the features of the American Indian's life well adapted to being taken over into our white civilization, the silent sign serving many purposes in the modern world. The Boy Scout movement has taken up the sign language with eagerness; and its use as an adjunct to the hand-alphabet of the deaf and dumb has scarcely been explored. Probably no other phase of Indian culture has proved so interesting to the American public at large.

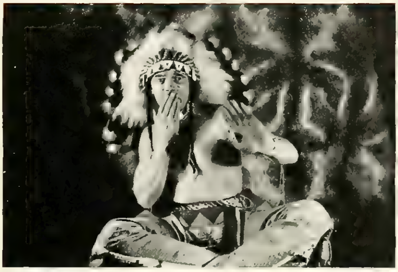
At present there are comparatively few Indians left who can talk sign language fluently. Those Indians so fortunate as to have learned the flow of signs from the generation which went before them are now aged survivors; and the time is near when the best speakers will be no more. There is a real need, therefore, to kindle a broader interest in the sign language and to preserve it for the future.

John P. Harrington

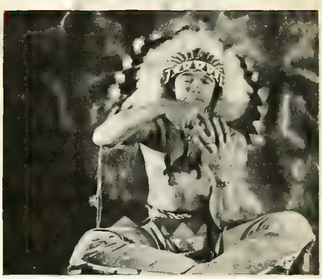
Bureau of American Ethnology, Smithsonian Institution



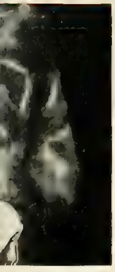
'HUNGRY" Motion like sawing body in two with edge of hand



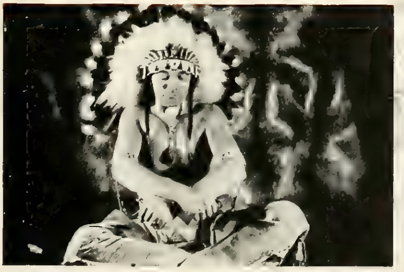
INTERJECTION: "ALAS" Means also surprise or joy with appropriate face



PREP: "AMONG" Weaving motion among fingers



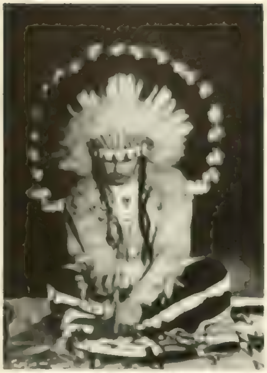
finger, denoting
alls backwards
rd



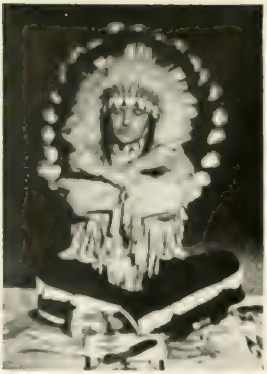
VERB: "CAPTURE" The posture of bondage signifies to capture or be taken prisoner

PUT THEM ALL TOGETHER AND YOU HAVE:

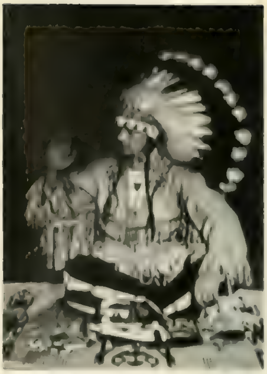
"I was so hungry, alas! that when I found myself among the Ojibway Indians I timidly allowed myself to be captured."



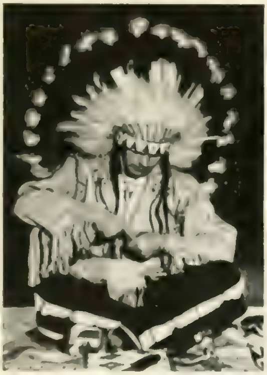
FIRE—Snap fingers up from thumb repeatedly, like leaping flames



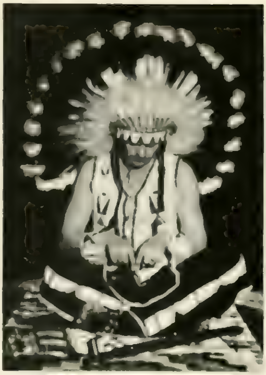
TRADE—From shoulder position, cross forearms, forefingers extended



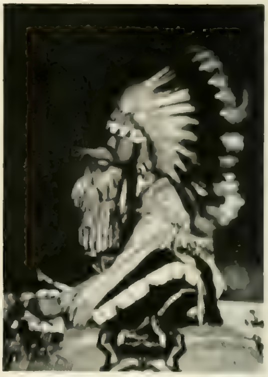
QUESTION Rotate raised hand in a small circle by wrist action



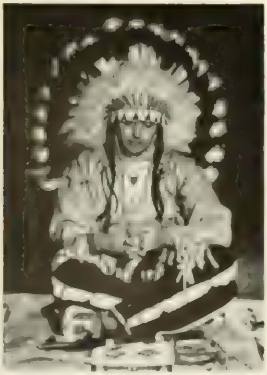
ARROW- Motion to shoulder imitating withdrawal of arrow from quiver



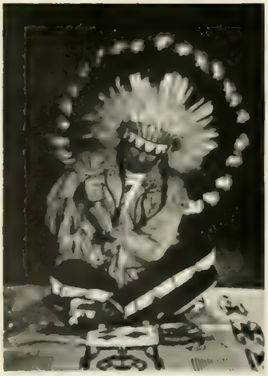
EQUAL—Forefingers move forward side by side, imitating an even race



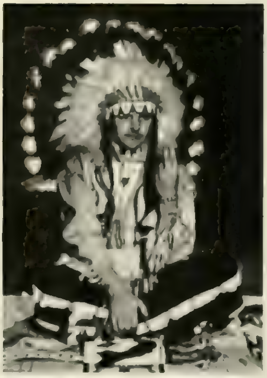
LIE—Two spread fingers show "double talk" or man with split tongue



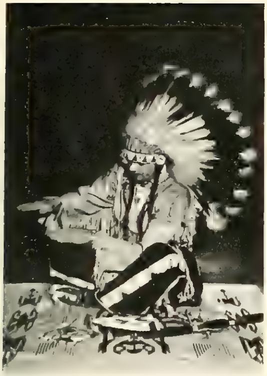
HOUSE Like a log house. Cheyenne pointed fingers up like gabled roof



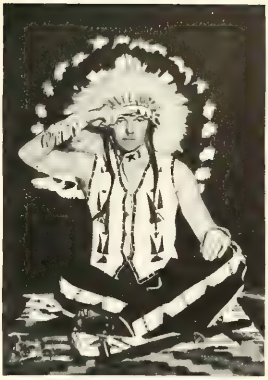
KEEP—Grasp moving left finger in right hand and hold firmly



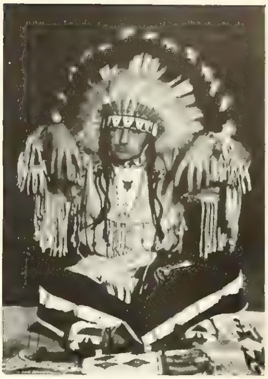
FRIEND—Forefingers together, meaning brothers growing up together



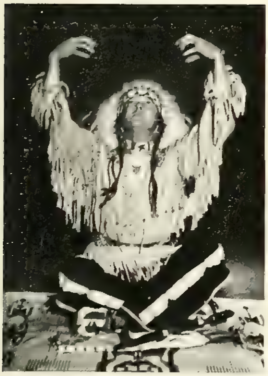
WALK—Move hands alternately forward, as if walking on hands



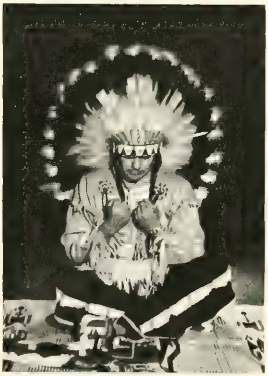
WHITE MAN—Indicate hat brim by drawing finger across forehead



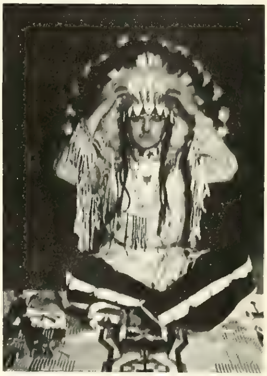
RAIN—Drop hands straight to waist
SNOW–Same swirling, like a blizzard



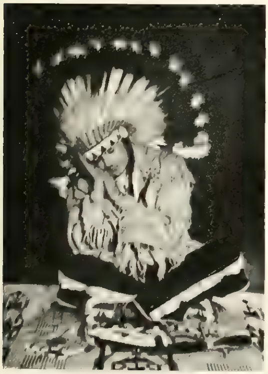
HOT—Hands sweep down and stop just short of head, like rays of sun



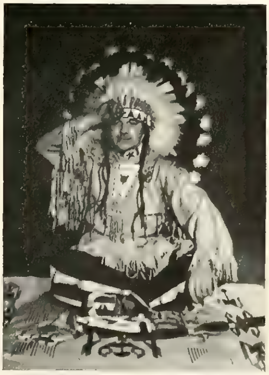
COLD—Fists are clenched as when cold, and brought against chest



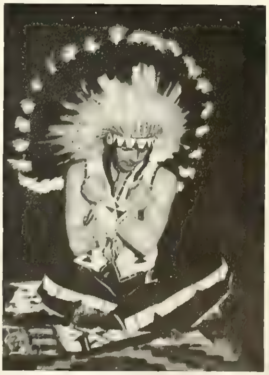
WOMAN—Like combing hair with fingers. This plus "little" means girl



SLEEP—A sign showing position of sleeping on ground, head on hands



CRAZY—Circular wrist action, not unlike "screwball" & "bats in belfry"



FOND—Crossed fists pressed to breast. Means also "love" and "like"

SIGN LANGUAGE IS SHORTER THAN ENGLISH

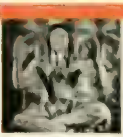
Over 1000 characters are necessary to tell this short story in English, whereas only 169 gestures are needed in the sign language. Read the English version first, then examine the Indian method of telling the story opposite.

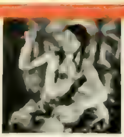
THE BOY WHO BECAME A CHIEF

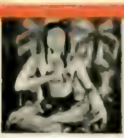
WHEN I was a little boy, I wanted to do big things for my tribe and be a great warrior.

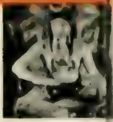
When at last I was grown, the Chief called me to his tepee and told me to go to the village of the Sioux, there to find out if they planned to fight us, or some other tribe.

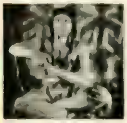
I was now a scout, and when night came I took a canoe and went up the river towards the Sioux camp. All night I went in the dark, and when morning came I made camp along the shore among the trees and stayed there all day.

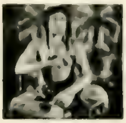

MANY
Hands dip and rise, almost touching

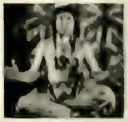

MOONS (ago).
Sign of quarter moon

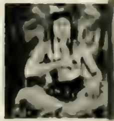

ME

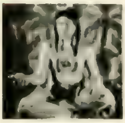

LITTLE

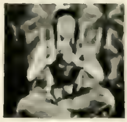

HORSE,

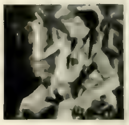

BE

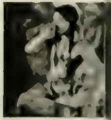

BIG

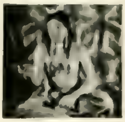

SCOUT.

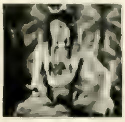

HIS

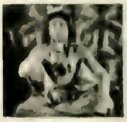

TEPEE.
Hands move down and apart

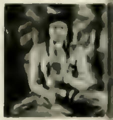

CHIEF
Motion for man above others

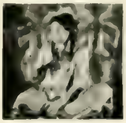

TELL
Flicking of forefi

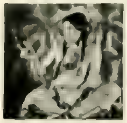

HE

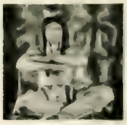

KNOW
Out from abdomen and back

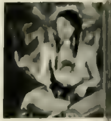

SIOUX
"Cutthroat"

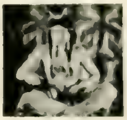

MAKE
Brush hands u and down

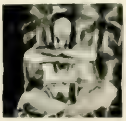

NOW
Hand flicks like marking an instant

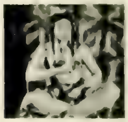

SCOUT.
"Wolf"

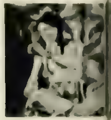

NIGHT
Like covering something over

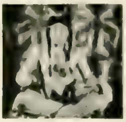

COME.
Motion towar speaker

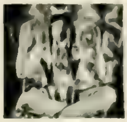

ALL
Hand moves in flat circle

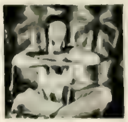

NIGHT
Like covering something over

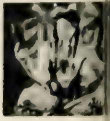

ME


PADDLE.

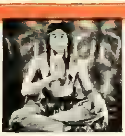

ALL
Hand moves in flat circle


DAY.
Crossed arms uncover something

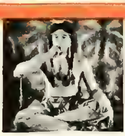

NIGHT
. . . . and cover it over again


COME.
Motion towar. speaker

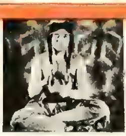
MAN.
Upright finger



ME

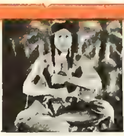


WANT
Several downward twists of wrist



MAKE
Brush hands up and down

BIG



WAR,
Fists circle each other

GO
Hand dips away

CAPTURE
Posture of bondag

Me" plus "wolf"

ME

GROW UP.

CHIEF
Motion for man above others

TELL
Flicking of forefinger from thumb

ME

COME
Motion toward speaker

TO
Finger jabs palm

ME

GO
Hand dips away

TO
Finger jabs palm

VILLAGE
"Tent cluster"

SIOUX
"Cutthroat"

INDIAN
Circular rub denoting red skin

STAY.
Fist thumps air

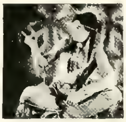
WAR.
Fists circle each other

CHIEF
Motion for man above others

TELL
Flicking of forefinger

ME

LISTEN,



SCOUT
"Wolf"

SIOUX.
"Cutthroats"

ME

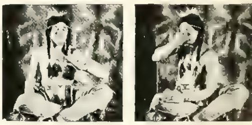
ME

TAKE
Hooked forefinger toward body

CANOE,
Paddle plus curved bow

GO
Hand dips away

UP



RIVER.
Wave-like motion
Drinking gesture

MORNING
verse of "night"

COME.
Motion toward speaker

ME

MAKE
Brush hands up and down

CAMP
Hands move down and apart

AMONG
Weaving motion

TREES.
Hands tremble like leaves

STAY
Fist thumps air

ME

TAKE
Hooked forefinger toward body

CANOE,
Paddle plus curved bow

GO
Hand dips away

UP

RIV—
Wave-like motion

Continued

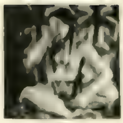
THE BOY WHO BECAME A CHIEF

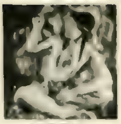
When night came again, I continued up the river, and when the moon was high I came upon the Sioux village.

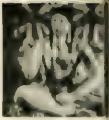
While I was listening to one of the old men talking, one of their scouts saw me and captured me. I was brought before the Chief, and he told me that I was to die in the morning.

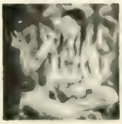
I was then taken to a smaller tepee and held captive there, but during the night I worked hard to escape, and finally got free. In order to get away, I had to kill the scout and steal his horse. I rode as fast as I could until I was at the river again, where I hid until nightfall. Then, on the rested horse I hurried back to my father's village and told the Chief all that I had seen and heard. The Chief was thankful and he made me a subchief.

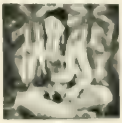
Continued from preceding page

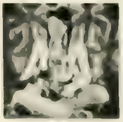

ER
Drinking gesture

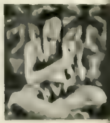

MOON
Sign of quarter moon

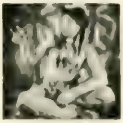

HIGH
Directional moti toward zenith

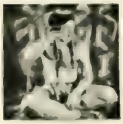

WOLF

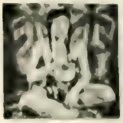

NOW,
Hand flicks like marking an instant

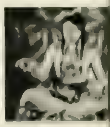

GO
Hand dips away

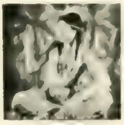

TO
Finger jabs pal

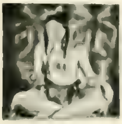

SCOUT
"Wolf"

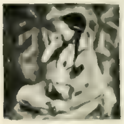

SEE
Sighting along two spread fingers

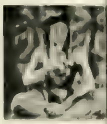

ME.

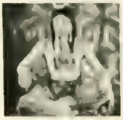

TAKE
Hooked forefing toward body

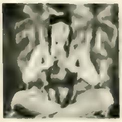

CHIEF.
Motion for man above others

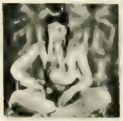

HE

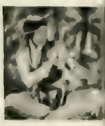

SAY
Forefinger flicks

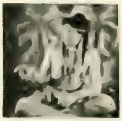

ME

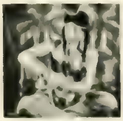

LITTLE

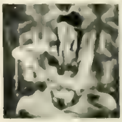

TEPEE.
Hands move down and apart

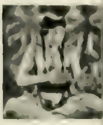

ALL
Hand moves in flat circle

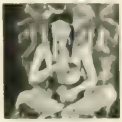

LONG
Like drawing a long bow

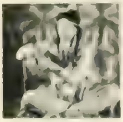

TAKE
Finger hooks toward body

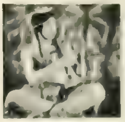

HORSE,

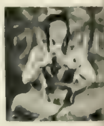

RIDE
Galloping motion

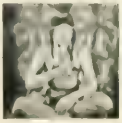

FAST
Hand brushes p other hand

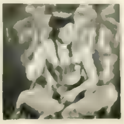

ME

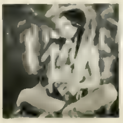

RIDE
Galloping motion

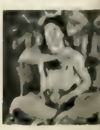

TO
Finger jabs palm

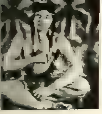

VI
"Te


ME

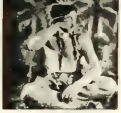

HEAR.


CHIEF

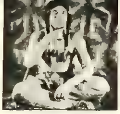

HEART



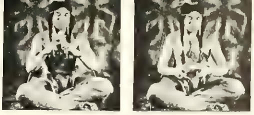
ME



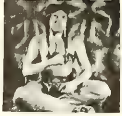
SEE
Sighting along two spread fingers



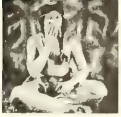
SIOUX
"Cutthroats"



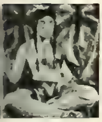
VILLAGE.
"Tent cluster"



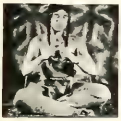
ME



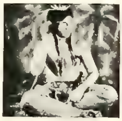
SILENT



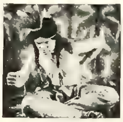
BIG



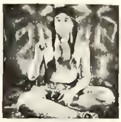
TEPEE.
Hands move down and apart



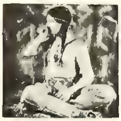
HEAR



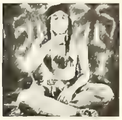
OLD
Aged person with stick



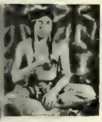
MAN



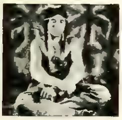
TALK.
Forefinger flicks



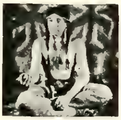
SIOUX
"Cutthroat"



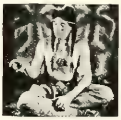
ME



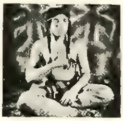
CAPTIVE.
Posture of bondage



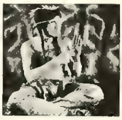
HE



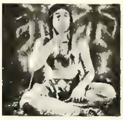
TAKE
Hooked forefinger toward body



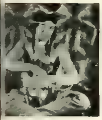
ME



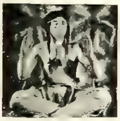
TO
Finger jabs palm



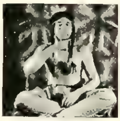
SIOUX
"Cutthroat"



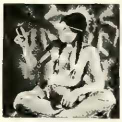
DIE
d or finger goes ler other hand



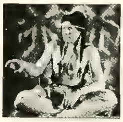
DAYBREAK.
Crossed arms uncover something



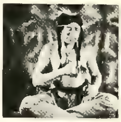
SIOUX
"Cutthroat"



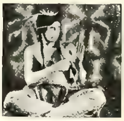
SCOUT
"Wolf"



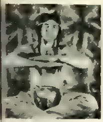
TAKE
Hooked forefinger toward body



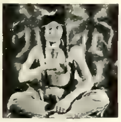
ME



TO
Finger jabs palm



NIGHT
ike covering mething over



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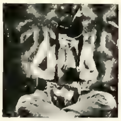
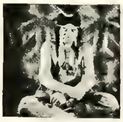
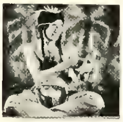


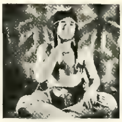
STRUGGLE.
Fists leave body with effort



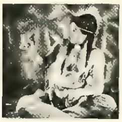
ESCAPE!
Bondage broken in upward motion



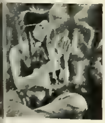
KILL
Finger cuts through spread fingers



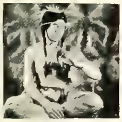
SIOUX
"Cutthroat"



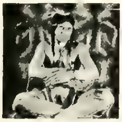
SCOUT.
"Wolf"



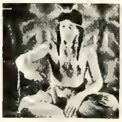
TO
nger jabs palm



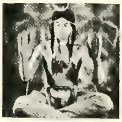
RIVER.
Wave-like motion



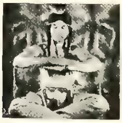
HIDE
One hand hides behind other



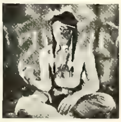
ALL
Hand moves in flat circle



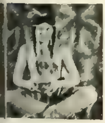
DAY.
Crossed arms uncover something



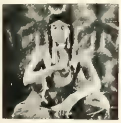
NIGHT
Arms return, like a lid



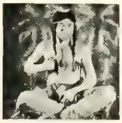
COME.
Motion toward speaker



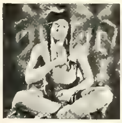
.GE
uster"



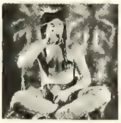
MY



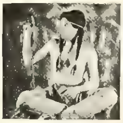
FATHER
Fist touches right breast



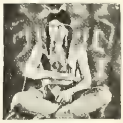
ME



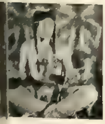
TELL
Flicking of forefinger



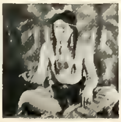
CHIEF
Man over others



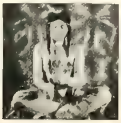
ALL
Hand moves in flat circle



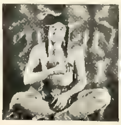
GLAD.
otion of being



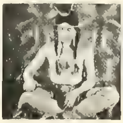
HE



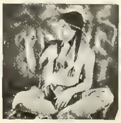
MAKE



ME



LITTLE



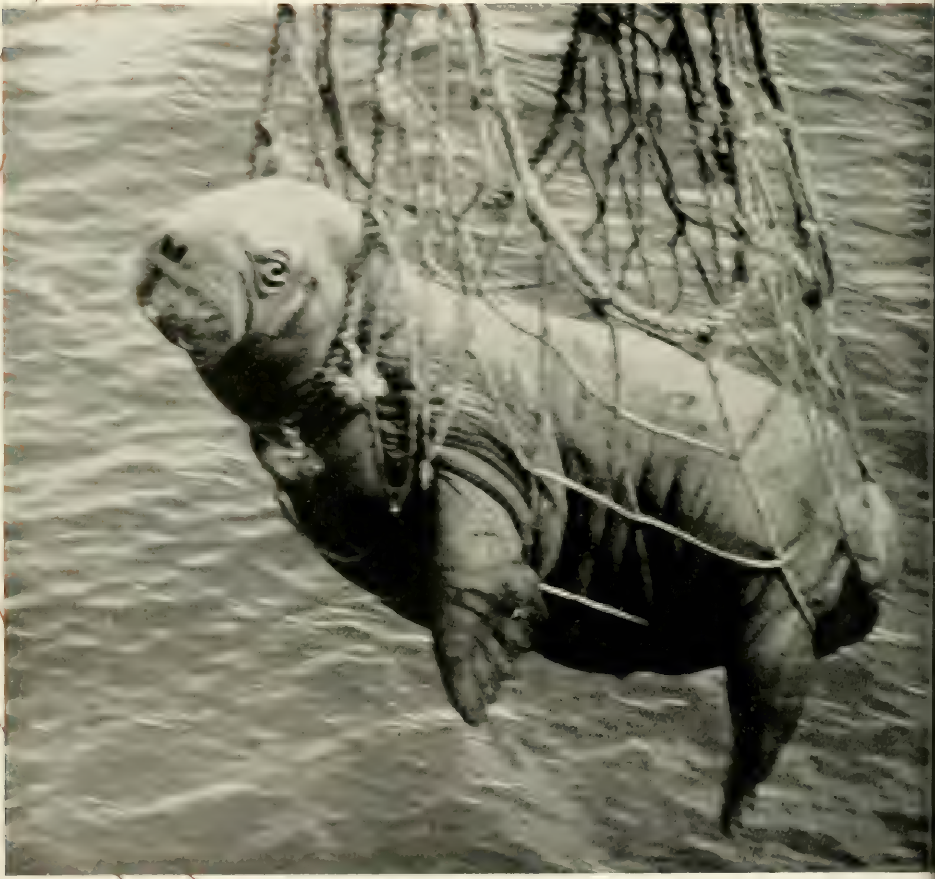
CHIEF.

END

PARKY

The story of a young walrus who traveled farther south than his relatives in Bering Strait

By Woodbridge Williams



PANIC! even his bellowing ceased, but his globular eyes betrayed the fear that this 150-pound baby felt while being hoisted through the air

AT HOME on the floating ice north of Bering Strait, Parky's herd indulged in the pleasant pastime of sleeping in the warmth of the Arctic sun, unaware of dangers

PARKY was no ordinary infant, in fact he was quite a singular creature. Already his sparsely-haired, thick, gray hide was furrowed and creased as if by age—quite a peculiar state for a baby only two weeks old. And his shape? Well, it was rather indefinite. He would at times suggest a little hippo that had sprouted flippers on the ends of his stubby legs instead of feet. But it would really be difficult to compare any other living animal, except perhaps the seal, with this good-natured, roly-poly infant walrus. His unique voice with its plaintive variations was something like that of a seal, but much more expressive.

At the moment Parky was not expressing himself audibly, as he was quite contented. He lay in the warmth of the Arctic sun on a glistening ice pan. All about him the dingy gray mounds of the sleeping walrus herd were sprawled and piled upon one another in wild confusion. He felt secure among these dormant heaps of quiet power, especially because surrounding him were the bulky bodies of his parents, which roughly circumscribed the small area in which he rested. When approached by danger, his mother, by pushing him in front of her with her massive chest and guiding him with her fore-flippers, would propel her offspring toward the sea and safety.

Parky's parents meant more to him than safety. He found fine sport swimming and playing with them in the sea. There he felt more at home than slithering about on the slippery ice. He and his elders would dive and leap in a way that suggested the antics of dolphins.

Perhaps Parky's major interest in life was food. He was about a 150-pound baby; such an infant requires an abundant food supply. Quite often he would retire to his mother to indulge in his favorite pastime of feeding, and in this he acted like any young dog or pig or calf, for he was just as much a mammal as any of them. His mother, in order to feed such a large, ravenous youngster, required a great deal of nourishment herself. Her diet consisted principally of clams, for which all her seemingly peculiar and useless structures were very well adapted. With her tusks, she dislodged the mollusks from the ocean bottom; with her large flattened teeth, she perhaps crushed the shells before swallowing. Her thick coat of blubber beneath a tough hide protected her from the cold of the depths. Powerful muscles enabled her to descend to the walrus meal table, which in Parky's locality was 180 feet beneath the surface of the Arctic Ocean.

Parky showed no signs of tusks; his two front upper canines had not yet developed into these specialized structures possessed by the grown walruses. Only the flat molars which just protruded above his gums gave any indication as to his future inclinations toward a clam diet.

As he now nestled drowsily beneath the protection of his parents, he little dreamed of the numerous dangers which constantly beset the herd. A young walrus would make a tempting and easily captured meal for a hungry polar bear; but this danger was small, at least in this period of walrus history, compared with the destruction wrought by two-legged creatures who killed from great distances. Every winter Parky's herd followed the growing ice pack southward through Bering Strait and into Bering Sea, keeping close to the outer edge of the floes where open water could be sought for safety.

From the Diomede Islands in the center of Bering [illegible] north of Nunivak Island range the Eskimo settlements whose inhabitants take great numbers of walrus [illegible] the herds [illegible] southward by the ice during the long winter months. Today as long ago the Eskimos hunt the walrus from their native umiaks, long walrus-hide boats, constructed of a framework made from driftwood lashed together with seal and walrus-hide thongs. Most likely though, these craft would not be propelled by the ancient paddles or oars, but by 25-horsepower outboard motors, which literally cause the craft to skim over the water. And rifles have largely taken the place of the cleverly devised native harpoons which, instead of allowing many a fatally wounded walrus to sink, held it captive on the end of a rawhide line.

With the deadly rifle the natives hunt their traditional game, the walrus, often killing great numbers of them not so much for food as for the ivory tusks which, when carved into various useful articles, are traded profitably with the white man from the south.

Parky knew nothing of these dangers which existed to the south of his summer home in the Arctic Sea. He had never seen the destructive creature who walked on two legs until one sunny July day when a large white ship loomed on the blue-gray horizon.

A fateful sound

The hum of an outboard motor propelling a skin umiak, and the muffled roar of a white power launch broke the stillness of the great ice-dotted sea. Only occasionally would a one-ton bull rise on his fore-flippers to look into the distance and perhaps emit one or two half-hearted bellows of defiance. Parky's parents lazily looked up and then relaxed again into a coma of indifference.

But now the launches approached closer to the herd. Walruses on the outskirts began to waddle off the ice into the water. Those with young pushed their offspring toward the sea.

Suddenly! two, three, perhaps more rifle shots cracked above the general roar of the now awakened herd. One bull, distinguished from the females by his heavier and thicker tusks, was hit, but before death overtook him, he slid off the edge of the ice, sinking from sight. Following the gun reports, a general alarm swept through the herd. Like a well-trained army they slid, angry and frightened, off the ice. In the churning water, several of them headed for the two boats. Parky found himself catapulted into the sea and carried along in the confusion of great, powerful moving bodies. The umiak quickly turned and retreated toward open water. Its Eskimo occupants knew only too well from past experience that an angry walrus would not hesitate to ram its tusks through the skin bottom of their frail craft. The launch, though, lingered awhile. One maddened walrus attacked. A rifle was carefully aimed at the oncoming foe. Then click, something had gone wrong with the gun. The walrus had time to dive beneath the launch, striking the wooden hull with his tusks. Not even the planking stopped the powerful thrust. The ship's carpenter was busy that day repairing a hole in the bottom of the boat.

Capture

Again the following day two moving objects came away from the white ship and once more approached the docile herd. Parky's family were oblivious to the world. The summer sun was warm, making sleep the most pleasurable pastime. The umiak approached the ice pan upon which the family sprawled. Their bit of ice had drifted some distance from the main herd. Only the three lay upon it.

Approaching closer, the outboard was silenced. The umiak drifted quietly up to the ice, and a fur-clad figure raised his gun. A few shots, that was all. Parky's parents lay dead on the floe.

Only after their death were the crew of the umiak willing to land on the ice. Although the bewildered youngster could easily have taken refuge in the sea, he refused to leave the side of his slain mother. Several rough hands were laid on his struggling form. He was protestingly dragged to the umiak, rolled into the bottom, and securely tied to the boat's framework.

As the umiak leaped through the small waves, back toward the large ship, it seemed to express the joy of its crew over their final success in capturing a young, live walrus. But Parky felt no joy as the umiak drew alongside the ship, and he looked up into numerous, staring faces of curious humans. A cargo sling was dropped into the skin boat, and he was rolled into the net. The chugging of the winch announced his ascent. As he was swung through the air, his vocalizations ceased, only his globular eyes expressed the panic he felt. That was until he found himself on solid footing again. On ice? No, something just about as cold though, a hard iron deck.

* * * * * *

This is what we can piece together of Parky's life before he met man. The vessel on which he found himself was the motor ship *Stranger*, of Los Angeles, California, on cruise in Alaskan waters. One of the vessel's aims was to obtain Arctic animals for the San Diego Zoo. There was great excitement on board when Parky was lowered to the deck, excitement which confused the 150-pound baby. In bewilderment

Parky clumsily untangled himself from the sling and lumbered about the deck, bellowing with fear.

For some strange reason Parky found a particular attraction in the drain in the scupper. Placing his mouth over it, he would suck with all his might, producing a sound like a pump sucking nothing but air. Perhaps he was hungry and his desire for food even overcame his panic which his strange surroundings had brought on. Pathetically he attempted to locate his mother.

But Parky, like many other infants, was remarkably able to fit into new conditions and he was able to sleep away his troubles soon after he arrived on board. After perhaps an hour or so of wild clambering from one side of the ship to the other, he curled up in a corner and went to sleep. But what a noisy sleep! One would think he would wake himself up. No, it wasn't exactly snoring. There was no rumble of the breath going in, only the hiss when it came out, like the escape of compressed air from a vent.

A young Alaskan hair seal had been on board for about a week, and had been named Muckluck. As "muckluck" is the term applied to the Eskimo sealskin boot, it was decided that the young walrus should be called "Parky," which is the Alaskan word for a hooded jacket. Parky and Muckluck became the most interesting pets on the ship.

It was about two weeks before Parky would feed himself. For several days he sulked in the corner of his cage. His new home was cleverly built by the ship's carpenter, with a pool about two feet deep for bathing and a platform on which Parky could rest. At first his mealtime was a rather strenuous event, with two men holding him and one forcing nourishment between his bristle-like whiskers, over which during the struggle most of the milk drooled to the deck.

Bottle-fed

Parky was fed from a large bottle containing about two quarts of milk, some water, and a little cod liver oil for his vitamin. As time passed, the strenuous periods of forced feeding became less of a struggle. Gradually the bottle became to Parky not an object of fear but of pleasure. By the time the ship in its southward journey had again entered the Pacific Ocean, he was consuming about a case of canned milk every two days.

After a bit, Parky did not shun the strange humans who came about his cage making queer noises, or trying to touch him. In fact, he began to enjoy their presence, especially when they would pat his head or allow him to rub his bristly mouth across their hands.

Like most infants, he loved to show off. When an audience was present, he would stand in his tub of water on his hind flippers, placing his fore-flippers against the sides of the enclosure. He would look at you a moment as if to say, "Well here goes!" Then he would flop over backwards into his tank; and with grunts merging into gurgles as he sank, he would disappear completely. A few moments would pass, then his rise to the surface would be indicated by the bald hump of his head, which arose like a rounded back of a miniature whale returning to the surface after a period of abysmal wanderings. His pig-like eyes would next again see daylight, then his Fuller-brush whiskers appeared. Only Parky's comical face protruded above the surface, looking at you as if to ask, "Well, how was that?"

Parky found great interest in the large salt water hose which was used to wash down the ship's deck and also to fill his tank. The hose was often left running in the tank. He would occasionally persist in pushing it out onto his platform and seemed to enjoy playing with the snaky rubber tube, which gushed cold water all over him.

The pet of the ship

Parky had become spoiled; perhaps that was the major reason leading to his downfall. He had come to be a tame and affectionate pet. Whenever left alone, if not asleep, he would more than likely begin bellowing for attention, food, or both. The crew certainly answered Parky's demands for attention, petting him whenever they passed his house. His caretaker, of course, was not quite so liberal with the feedings.

Parky's skin was thick, yet tender. It cut easily; several gashes about his neck showed this. These injuries did not seem to heal. As the ship neared British Columbia, Parky became quite ill. Perhaps he caught cold, if such is possible for a walrus; or maybe the large quantities of hay stored beneath his quarters in the well deck affected him in the same way that it does penquins, by producing a fungus growth in the mouth. At any rate, Parky was never to see his destined southern home in the San Diego Zoo. Perhaps it was for the best, for the balmy winters of that southern town are not in keeping with the cold in which his relatives thrive.

Parky's death marked the conclusion of an acquaintance with a unique and interesting animal, an animal whose intelligence seemed equal to the California sea lion's. Those who might have seen him in the confines of a zoological park would never have known the little animal who, in a state of semi-captivity on the deck of a ship, had amused so many with his lively antics in the brisker climate of his homeland. Let us hope that Parky's passing is not an indication as to the future of his already declining race.

(Above and below) EVERY WINTER walrus herds follow the growing ice pack south to Bering Sea, keeping near the edge of the floes where, at a moment's notice, Parky's mother could push her offspring into the comparative safety of the water

(Right) WITH MOTHER—but not for long. Only after his parents' death did the two-legged enemies dare to roll Parky into the bottom of their skin boat

ON DECK. The *S.S. Stranger's* passenger, bound for the San Diego Zoo (which he unfortunately never reached), became a tame and affectionate pet. Parky responded to his appreciative audience with lively antics; for, like most infants, he liked to show off

(Below) AT FIRST it took three men to force nourishment through his Fuller-brush whiskers, but he was soon guzzling his bottle without fear

THE BIOGRAPHY OF CHELYDRA—*Long-lived snapping turtle, fierce, sullen and unthinking creature whose enemies are thwarted by the house he wears on his back*

By Roy L. Abbott

The biographer of such a notoriously long-lived creature as a snapping turtle is of necessity embarrassed by the shortness of his own life span. Especially is this true if the biography attempts to record the writer's observations throughout the life of any individual turtle. But if he has seen, as has been my good fortune, fragments of the lives of many individuals of the same species—the mating and egg-laying, their birth, infancy, youth and age, even their death—is it not permissible to set these parts of lives down as one synthetic whole? At any rate, after over 40 years of observation, I present you with the composite story of the life, as I know it, of Chelydra, the snapper.

The summer sun from June to September had beaten upon that sandy spot in the watermelon patch. There, several inches below the surface, lay 20 or more round white eggs, appearing for all the world, except for their slightly smaller size, as if someone had buried a quantity of ping-pong balls. I was certain of this because I have dug up snapping turtles' nests, and in this case, because I had come upon the old female at her egg-laying that June morning and had marked the nest site of which I now tell. But early as I was that day, she must have begun her journey far earlier, for the nearest water was a creek at the bottom of a steep, wooded bluff, perhaps 200 yards away; and even then, as I found her, she was backed into the soft soil to a third of her length, just completing the job of egg-laying. I did not see her dig the nest, but from watching others, I know that she did it largely with her webbed hind feet, perhaps aided somewhat by her powerful tail, and that after depositing her eggs she crawled out, pushed dirt into the hole, flattened it down a bit with her under-shell and then slowly moved back to the creek, her heavy tail marking a curving line between her widely-spread tracks as she went. The whole process seemed casual enough, and although she threatened me with her great jaws when I first came upon her, I doubt that she fended me off as being in any way a possible depredator of her offspring, nor that her maternal feeling on that occasion was any more than a vague inner urge to get rid of the crowding eggs. Certainly, so far as I know, she never revisited the nest site, probably, indeed, never saw any one of the youngsters that came from the eggs, and perhaps, never again met the big male who sometime before, had done his part in providing for the new generation.

Turning eggs into turtles

Seemingly indifferent as Madame Snapper was to her eggs, she had at least placed them in a suitable spot on the land, a thing which every other egg-laying reptile does regardless of habitat, and Mother Nature, in her inscrutable way of looking after her children, had seen to the rest of the job—the job of turning the eggs into turtles. Nor was it any little task, for those rubbery shelled eggs were at first only masses of food and water and protoplasm—organized masses, it is true, but as yet having no internal resemblance to a turtle, looking instead very much like birds' eggs, a central core of yellow surrounded with a watery white just inside the shell. It takes four months or thereabouts to change this egg-content into a fully-formed snapper, four months of cell division and tissue formation, of shift and change and organ-making, not the least of which is the building of the creature's upper-shell. For early in development, that structure, appearing as a sort of raised area in the center of the back, grows rapidly outward and downward over the rest of the embryo, somewhat like thick lava capping a low mountain, and, incorporating itself with the ribs, soon spreads enough to pull even the shoulder and hip-girdles under its protective roof. This upper-shell eventually fastens itself at the sides to a similar flat plate of bone at the bottom of the embryo. Hence the snapper, willy-nilly, and in common with all turtles, comes into being all boxed up, confined paradoxically to a sort of open box—open at the ends for protrusion or retraction of head and tail, and also at each corner for free action of arms and legs.

Many turtle nests that I have marked for study have been dug up and destroyed by some predatory animal. The common skunk is notorious for his destruction of the eggs of the snapper. But this particular clutch escaped injury, and my 20 young snappers—as I had the good fortune to meet them there that September day on my daily trip to the nest—seemed in nowise discouraged by their physical limitations. Indeed, boxed up and feeble though they were, I couldn't help thinking that they had gotten a long way from the tadpole, gill-breathing stage of their frog-like ancestors; and they had at least one advantage over most of the newborn mammals, for their eyes were open from the first. Nor were they bothered by the fact that they were far from water. Stretched out in a ragged line, with all the seeming assurance of a hundred million years of reptilian success behind them, they were heading straight for the creek which was at the foot of the bluff and at least 30 feet below their line of vision.

How did they know where they were going? Who knows? G. H. Parker, of Harvard, studied young loggerhead turtles and concluded that they went down to the sea as a response to the more open horizon in the seaward direction; and other observers of newly-hatched snappers state that they go towards the largest illuminated area. But certainly other factors were operating here, for the brood was heading eastward directly into and through a high hedge-fence, with the wide, open horizon at their rear.

No snap to be a snapping turtle

And how many of my 20 hatchlings survived the vicissitudes of the next ten or fifteen years, or whatever time it takes for a snapper to arrive at the full status of snapperhood? Again, who knows? Certainly there were dangers aplenty. Not from lack of food, for fall-hatched turtles can go until the next spring, even far into the following summer, with little or nothing in the way of sustenance; they appear to carry a considerable reserve of food from the egg. But I took a baby snapper (measuring one and one-half inches across the shell) from a bullfrog's stomach a short time ago, and one of about the same size from a three-pound black bass. Hence, when they first arrive at the water as soft-shelled, swimming, half-dollar-sized infants, they are doubtless tempting and easy morsels for those creatures—scaled, feathered or otherwise—that live by gulping whatever prey of suitable size moves within range of their jaws.

Regretfully, I now realize I missed a chance the day I met those little snappers trekking from their birthplace down to the creek. For had I captured two or three and kept them through the years, I would now be able to give some accurate data upon their rate of growth, of which we at present know but little. A. S. Pearse and Edward S. Hathaway found that two Western painted turtles, which they tagged and subsequently recaptured, had grown just less than a third of an inch in shell-length in two and one half years, and from this they calculated that five-inch turtles of this species would be about twelve or thirteen years old. According to Clifford H. Pope, a Marion's tortoise is known to have lived on its "native Island of Mauritius from 1766 to 1918 when it was killed in an accident." He also cites that snapping turtles have been kept in Europe for periods up to 20 years.

Full snapperhood comes slowly

Well, I too, have two large snappers. I caught them in 1920, and they have been under my constant observation ever since. But unfortunately I did not measure them when first captured, and although still active and vigorous as ever, they do not appear to have grown very much in 20 years. Contrary to the usual run of affairs, the male is somewhat larger than the female, weighing about 20 pounds. But how old were they when I got them, and how long does it take a snapper to grow up?

A tiny one, which I have kept in my office for the past full year, has gained exactly eight-tenths of an inch in shell-length, and now measures just two inches—a small gain, considering that he has fed greedily upon liver, meal worms, and earthworms for most of that period, sometimes consuming a dozen fat meal worms at a single feeding. Does this mean that snappers grow very slowly?

But to return to my hatchling snappers as I watched them take to the creek that day. I have already asked how many of them survived that first dangerous year, becoming full-fledged turtles at least ten or fifteen years later. Of course I couldn't follow them beyond their disappearance into the water, but it's a safe bet to say that, being 20 in number, they had similar but twice the troubles of the "ten little pickaninnies." Doubtless one had scarcely reached the water when a bullfrog swallowed him; another, lying momentarily at the surface, was taken in a furious rush by a big bass or a pickerel; and a heron, mayhap, gulped a third. Before the end of the next year, half of them may have disappeared—the substance of which they had been composed, by the alchemy of Nature, now rebuilt into other creatures, whose fate it was in turn to be transformed into yet another. And by the end of fifteen years, if snapping turtles be full grown by that time, how many would be left? The mathematics is simple enough: at least two, if the species is to keep constant its numbers. But since the snappers are on the decline in these parts, only one is left, a huge fellow, fourteen inches in length of shell, with a neck as thick and long as a man's upper arm: *Chelydra serpentina,* the scientists call him. And [illegible] I [illegible] episode in the life of this one snapper all the ways and doings of the several snappers I have met?

Tough constitution

Chelydra came first [illegible] experience [illegible] fishing. I was fishing that day on a Mississippi River slough, my attention was caught by a succession of [illegible] which came floating slowly past, each appearing to have a large piece scalloped from its side. On investigating my catch, which was tied up stream, I found a huge snapper cutting a fish from the string at every bite and carving a mouthful from each as cleanly as I might bite a piece from a pie. I drove him away with a .22 rifle, but the hasty shot landed pretty far back, and knowing his amazing toughness of fiber, I suspect that he may still be alive. For he and his kind can stand a great deal of injury and still live. Raymond L. Ditmars tells of finding a turtle on the field of Bull Run a few years ago—a turtle hale enough, but whose healed shell showed all signs of having been once nearly cut in two. "A minnie ball," suggests Ditmars.

Well, it is credible enough, for I found a Blanding's turtle with its shell showing signs of having once been stepped on and crushed, perhaps by a horse. Its carapace was smashed down an inch or more, yet the animal appeared otherwise normal, and the shell thoroughly healed.

Chelydra, like many other turtles, hibernates in the wintertime, often remaining buried in the mud from November to April. Of course he does little lung breathing during this period. Though he may even remain under water for hours when not hibernating, he is an air breather during his active hours, and will drown if compelled to remain under water too long. I discovered this latter fact rather incidentally a few years ago when I went with a friend to help find a hoop net which had broken from its moorings. The net had disappeared for several days, and we finally found it floating, buoyed up by the gas-filled bodies of several large, drowned snappers.

I met Chelydra again—in rather a collective sense this time—when I set out not long ago to prepare nine large snappers for dissection in a zoology class. These nine were fresh from the creek; and, although I'd never tried it before, I decided to use a lethal chamber on them—natural gas turned into a telescoping pair of tin tubs with a water seal. It had worked admirably on cats; but after tumbling the snappers into the box, turning on the gas and waiting 30 minutes, I was not prepared for what I found on lifting the lid. For each of the nine lay there calmly regarding me with their little, yellow-gray eyes, as fierce and ready for battle as ever. I tried them for a second period, but it was of no use. I believe they took only a sniff of the gas and then knocked off breathing so to speak. Although both the silence and my astonishment were profound as I viewed them, I had a sort of guilty feeling that they were asking me: "Why did you turn that vile stuff in here?" Nor could I find a very satisfactory reply to the query.

I met up with Chelydra still another day. Perhaps a mile from the nearest water, he was apparently migrating overland from one pond to another. He was making pretty good time at that—I guessed a mile per hour—holding his under-shell at least an inch off the ground, and with tip of tail dragging. He apparently knew also where he was going; for, although he stopped and struck savagely at my dog, turning quickly in circles to keep his head-end presented to his tormentor, when we left off teasing him, he started off again in the same direction.

Another one that I picked up while on an automobile tour was placed in the rear of my car for further examination, but I promptly forgot the creature. Although it endured the dust and heat of those cramped quarters for two weeks, it seemed but little the worse for the experience.

Savage disposition

But for all these sporadic meetings, my real acquaintance with Chelydra began with the one I captured in a minnow net just 20 years ago. He, along with a somewhat smaller female, was hauled out of a duck pond and transferred by means of a gunny sack to a pen in my back yard, and later to a greenhouse where the two have been ever since. Both were plentifully sprinkled with leeches, particularly around the eyes and under parts of the legs and body; and both were doubtless infested with internal parasites, such as trematodes and roundworms, for I have never yet found a snapper free from these. Both, too, were fierce, lunging brutes when first captured, striking out savagely at whatever came near, often grabbing each other's jaws and holding on like bulldogs.

But after a few days, they quit striking blindly at each other, or at me, and will now even take food from my hand. But their savage disposition is still with them; and, although less fierce than formerly, they still resent handling.

Shortly after capture, one or both—I couldn't be certain—disgorged half a pint or more of the seeds of a common water plant, some species of Potamogeton. Does that mean that snappers are vegetarian when necessity requires?

Be that as it may, my two specimens have subsisted solely on meat for 20 years—meat from an astounding variety of animals. In fact, I have found little or nothing of an animal nature that they won't devour living or dead, seemingly taking fresh or putrid meat with equal gusto. Mine have eaten dozens of rats of both gray and white varieties, sparrows, pigeons, frogs, tadpoles, salamanders, crayfish, ground squirrels, fish, earthworms, grasshoppers, and even one young turtle of their own kind. They will often seize a tough old barn rat, one at each end, pulling and mauling it for a half hour. On several occasions, I have watched the big male swallow a large barn rat whole, gradually ingesting it by prodigious gulpings of his thick, muscular neck. Regardless of kind, however, the food is always eaten underwater; for, as far as I can observe, the snapper is apparently unable to swallow in air. Chelydra always strikes from below at an animal swimming on the surface, with an amazingly quick serpent-like stroke, followed instantly by a retraction of the head to drag the victim beneath the water. There are no teeth in Chelydra's head, but his mouth is rimmed with a sharp, cutting edge, and the tips of both jaws are beaked like an owl's. Watching one of these deadly submarine attacks, it is easy to see why a snapper-infested pond is no place for young ducks, or for that matter, young muskrats or minks.

Ability to remain submerged

Except when hungry, Chelydra usually lies quiet, his algae-covered shell melting beautifully into the general pattern of plant life about him. Indeed, mine in their cement tank, seemingly go hours on end scarcely moving, except now and then to thrust their heads momentarily above water for a short breath. But even this need not be often. I tied one to a large rock a few days back, forcing it to remain submerged for two and one-half hours. There was no sign of injury, and he probably could have remained under much longer.

Like all reptiles, Chelydra is cold-blooded, his temperature being about the same as his surroundings, which means that when the water is cold, he is cold, and his physiological reactions correspondingly slow. Experiment, in fact, has shown that he digests twice as rapidly at 84°F. as he does at 64°F. Even with this in mind, it is difficult to see how he disposes of so much food, especially when Francis G. Benedict has shown that the energy needs of a ten-pound turtle could be satisfied for a month by about seven ounces of banana.

And how long will this pair live? I have already implied that the dangerous age for turtles is the egg-stage and the first few years after hatching. Chelydra seems to have but few enemies, aside from man, capable of doing him any harm once he has arrived at maturity. One of mine actually endured the assaults of an eight-foot alligator, appearing to suffer little harm from the alligator's vigorous but futile attempts to crush him. Hence, my snappers, now perhaps 35 or 40 years old, bid fair to outlast their biographer. They appear as hale and hearty as the day I first met them!

His fallen estate

Sometimes I creep quietly up to the tank and watch these two big reptiles without their knowing of my presence. To see them lying there submerged, resting on the bottom with their huge heads half projected, is usually sufficient to start a chain of biological thought. I am looking at creatures whose ancestry runs back nearly 200 million years, if the paleontologists are right. The ancestors of the snappers first hit upon the anatomical principles of a dry skin and shelled eggs with a protective amnion and an allantoic breathing-device, and were thus able to get away from the water and really occupy the land—something which their amphibian ancestors could never do. When I reflect, too, that of the 25 or more orders of reptiles that once occupied the land only four or five are now in existence, there comes a kind of pity for their fallen estate. But I lean closer and my shadow, darting across them, arouses their attention. Two pointed noses touch the surface, a few bubbles escape—and I am back again to the present. I see before me two great, bulky creatures, fierce, sullen, unthinking—creatures whose existence appears largely vegetative. Each has arrived at his present size by incorporating whole hecatombs of animals into his body—and when I look at his ugly, unprepossessing form, I am constrained to ask: To what purpose? But that is a part of the lure of him and his kind.

HARD SHELL—SOFT SHELL

Some 20 times in the course of its short life the hard-shelled crab discards its clothing to become temporarily the soft-shell of the epicure

By JULIAN J. CHISOLM II

W[illegible] every animal that has its skeleton placed on the outside [illegible] (*Callinectes sapidus* Rathbun) must throw off this shell to increase in size after the old shell has been filled with expanding body tissues. During the life of the animal, which averages about two and one-half years in females and three to four years in males, this operation is repeated [illegible]

Crabs, also, have marked powers of regeneration of lost appendages such as legs, claws and paddles. These are frequently lost in the struggle for existence and are replaceable in all except the last stage [illegible]

To facilitate the discarding of an appendage, there is a breaking point on its basal joint known as the "fracture plane." When the appendage is held or injured, a special arrangement of muscles breaks it off at that point. A diaphragm closes the end of the amputated leg and prevents both infection and loss of blood. Subsequent to this development, the adjacent cells rapidly proliferate to cover the injured area.

A few days after an appendage is lost, a protrusion occurs at the point of the break and continues to grow, in bud fashion, until a large sac is formed, which gradually takes the shape of a new but nonfunctional member. This covering is discarded the next time the crab sheds. If sufficient time has elapsed for the new appendage to reach maturity, the animal now has a new functioning limb which is somewhat smaller in size than a normal one. It takes at least two full sheddings on the part of the crab for a regenerated appendage to equal a normal one in size. A

A new suit for the blue crab means growth

crab may lose as many as eight or ten of its appendages at one time and still carry on and develop new ones.

The first indication that a crab is ready to shed is a dark line that develops around the two outer segments of the paddles. In several days this line changes to white and then to a light red or pinkish color. This development, along with a certain wrinkled condition that shows up inside one or two of the claws, indicates that the crab is ready to shed. At this time it is known as a "peeler" and it seeks the protection of a grassy bottom in shallow water, for after the shell has been shed the animal is soft and defenseless for two or three days.

The shell or carapace of a crab fits snugly to the hard parts of the lower surface but is not attached to them, so, at the rear margin of the shell, a gap appears as the "rank peeler" starts to throw off the old shell.

Shedding is a very tedious and intricate process involving considerable time and much muscular effort, with many curious motions and actions on the part of the crab. By virtue of the writhing motion of the animal, the carapace is forced upwards and the soft posterior of the crab protrudes through the opening. The greatest difficulty appears to occur while withdrawing the legs, especially the claws with their small joints. To facilitate this operation, a triangular piece of shell in the proximal end breaks loose, greatly simplifying the maneuver. Twisting, twitching, and jerking continue until the crab is completely free of the old shell.

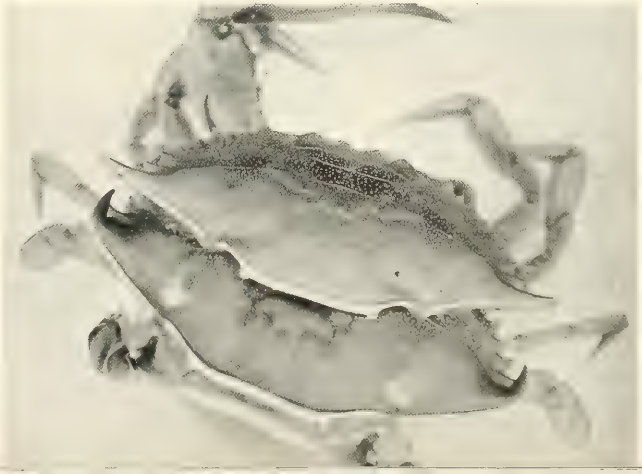
Almost immediately upon shedding, the spines recover their normal form, the legs are adjusted, and the animal is capable of locomotion. It becomes quite active and alert, being able to swim and walk in spite of its extreme softness.

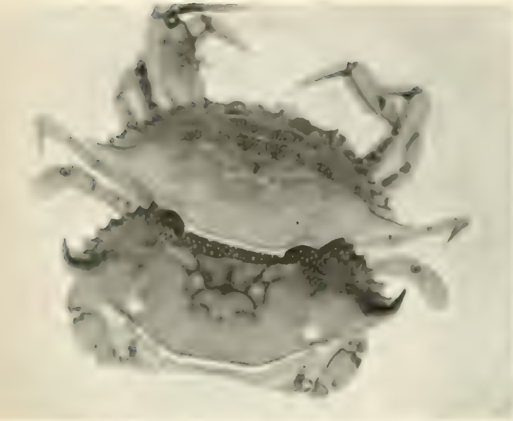
In two to three days the shell becomes hard and the crab starts to feed. At this stage it is known as a "buckram," and the body has spread to larger proportion. A crab gains about a third in volume with each shedding.

The photographs, taken in chronological order, show the various stages in the actual shedding process of a crab which had but one claw, and illustrate the powers of regeneration of a lost appendage.

1 *(Left)* 11:45 A.M. A HARD BLUE CRAB at the start of shedding. At this stage it is known as a "buster." The shell or carapace of a crab fits snugly to the hard parts on the lower surface but is not attached to them. In shedding, a gap appears at the posterior margin of the shell which continually opens as the carapace is forced upwards by the soft body of the protruding crab. Subsequent to its last shedding, this animal lost its right claw or chela. A sac-like growth can be seen in the place where the right claw should be. This is the new claw in the process of regeneration

2 *(Right)* 12:12 P.M. SHEDDING is a tedious and intricate process, requiring considerable time and much muscular effort, and involving curious motions and actions on the part of the crab. The carapace has been forced well up, and the posterior of the body with the paddles is nearly free of the shell. The sac containing the regenerated claw can still be seen. Notice the crack which has appeared in the left claw near the base. As this shell breaks away, it facilitates the withdrawal of the claw

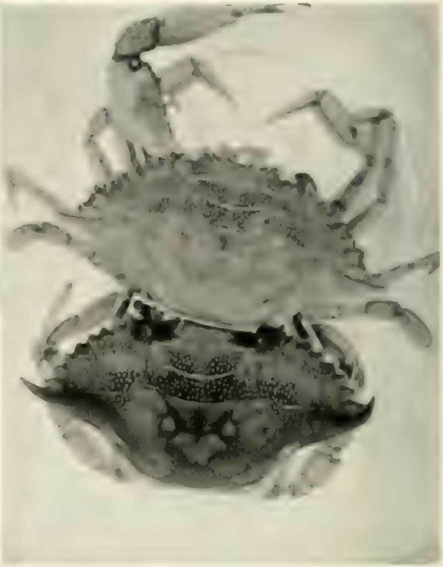


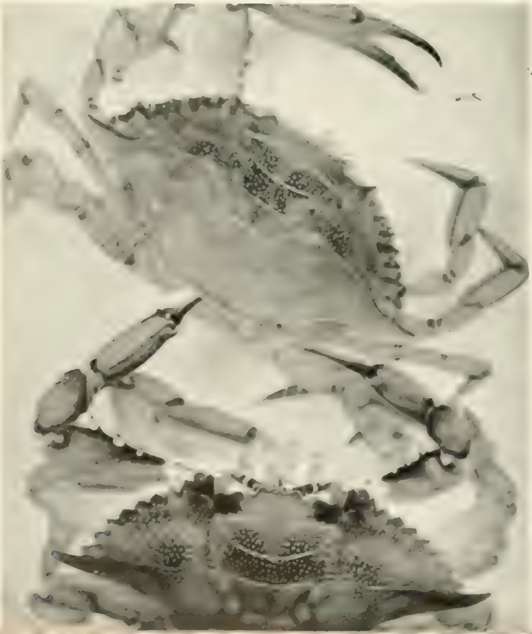


3 *(Above)* 12:17 P.M. WITH MUCH TWISTING and squirming the crab has succeeded in getting the greater part of its body free of the old shell

4 *(Right)* 12:22 P.M. AFTER A STRUGGLE of 57 minutes the body and legs are free of the old shell. At this point the greatest difficulty is experienced, that of withdrawing the claws

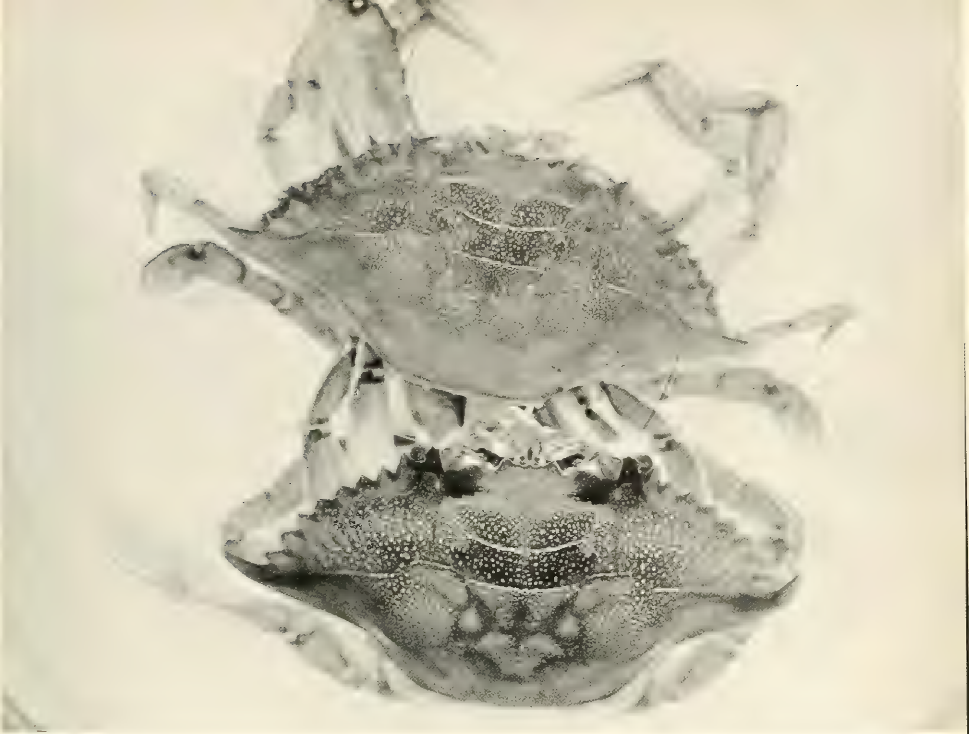
5 *(Opposite page)* 12:24 P.M. TWO MINUTES of frantic kicking and other gymnastics and the claws begin to come out



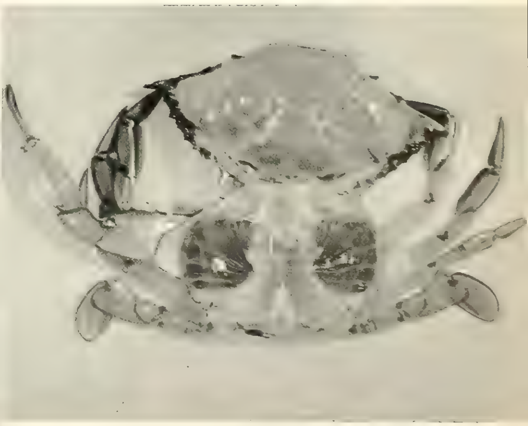


6 *(Left)* 12:28 P.M. SHEDDING IS COMPLETE. Note the perfect regenerated claw on the right. It is not as large as the left claw but will be after the next shedding, if nothing further happens. The crab's body is now extremely soft and is defenseless against its enemies. It will lie in hiding for two or three days while the shell hardens before venturing forth to resume feeding

7 *(Right)* 12:36 P.M. THIS SHOWS the increase in body-size after shedding. On top is the cast-off shell and beneath it the soft crab that came from it. Under normal temperature and feeding conditions, a crab gains about a third in volume with each shedding



8 *(Right)* THE CAST-OFF SHELL with the carapace opened forward to show the inside. As a result of shedding, all the hard skeletal parts of the crab are discarded, including the mouth parts, eye coverings, stomach lining, and gill coverings



BIRDMAN OF THE OPEN SEA

The career of Robert Cushman Murphy bears witness that the Age of Discovery lives on. For more than a quarter-century he has explored the oceanic waters off South America to spread before the world an entire new field of Natural History

By D. R. Barton

W[illegible] biological inquiry. Junius Bird,[1] the [illegible] wedge-shaped land [illegible] that cuts across all climate zones, from the standpoint of the human beings who dwelt thereon during the past [illegible] He [illegible] caves and other natural depressions, dug shallow pits, and brought forth artifacts classifiable, for the most part, on the basis of man-made "sediments" or layers of refuse. Owing to the comparatively late date of man's entry into the scheme of things, the archaeologist is not forced to rely so heavily on geological stratification as do paleontologists like George Simpson[2] who penetrated much deeper into South America's crust in search of the fossilized remnants of creatures dead these 60 million years and more. Thus do the manifold investigations which the Museum carries on in South America require downward penetration to varying depths. The reverse is also true. Frank Chapman[3] and Harold E. Anthony[4], among others, have carried the Museum's banner upward into the Andean peaks to collect specimens of birds and mammals in various high-ranging and sharply defined life-zones which reward the investigator with a remarkably varied gradation of fauna.

Having explored many of its plains and river basins, plumbed its depths, and scaled the summits of its loftiest mountains, it would seem that the Museum had exhausted all possible types of locality in South America. Yet it has remained for Robert Cushman Murphy to help establish and venture upon an entire new field of [illegible] which [illegible] from the world's longest coast line into the waters of the Atlantic, the Pacific, the Antarctic oceans and the Caribbean Sea.

With such a bailiwick marked out

Robert Cushman Murphy

for his own, Doctor Murphy has become the Museum's Ulysses, having probably served more years before the mast than any other curator. And, towering above his colleagues to his full 6′ 3″, he looks the part. During one South American cruise, he was bitten by a fer de lance. No fatality occurred, Roy Chapman Andrews later explained, because the recipient of the bite is so skinny the fangs simply pierced the leg, ejecting the venom harmlessly on the other side. As a matter of fact only one fang penetrated, but the venom stayed in the skin for some time, causing Doctor Murphy to limp painfully even after he had returned to the Museum. It troubled him psychologically, too. When he was least thinking of it, he would suddenly feel that fang sink into his flesh again. How the snake felt about it he does not know, but the foolhardy creature is generally believed to have died instantly as a result of the encounter. Though Murphy is on the slender side, Andrews' remark does not do him justice. Robust and aquatically minded from the start, he made the Brown University swimming team in college days and was capable of replacing the stroke oar in a whaleboat during his first expedition in 1912.

Brooklyn beginnings

Robert Cushman Murphy grew up near Port Jefferson, Long Island, where he lived in close contact with the birds of the sea and land from earliest childhood. His family wintered in Brooklyn, and there he made the acquaintance of George K. Cherrie and a number of other men in the Brooklyn Museum, absorbing considerable nature lore from conversations with them. He did a good deal of amateur schoolboy collecting of all kinds and eventually accepted a post on the Brooklyn Staff as Curator of Mammals and Birds (1911-17) and, later, Curator of Natural Science (1917-20). However, his connection with that institution was not without interruptions.

One day in 1906, Bob Murphy, then 18, wrote a letter to Curator Frank M. Chapman, whom he knew only by reputation, asking for a job at the American Museum. Chapman replied that he could give him work at $40 a month. This figure did not coincide with Murphy's own evaluation of his services and he promptly declined by mail. The letter was written on Saturday. Then, over the weekend, he reconsidered the matter and changed his mind. On Monday morning he rose early, came in to the Museum, pinched his letter of refusal from Chapman's desk, and sat waiting for the noted ornithologist to arrive. Thus began an association that has endured through the years and, significantly, Doctor Murphy's classic monograph is dedicated to the revered dean of American birdmen.

[illegible]

But that starting salary was awfully small, and although his family was able and more than willing to help out, Murphy sometimes lived on little more than dreams of the future. He was a proud young man and all he would allow his father to buy for him was a suit of clothes. On one particular occasion he had literally nothing to eat all day. Too proud to ask for an advance, he suffered the pangs in silence until evening when he read proof for the *Auk* with the late Dr. Jonathan Dwight. As he was about to leave, Murphy thought of dropping a gentle hint, but again overcame the impulse. It was only at the last moment that Doctor Dwight asked casually if he wouldn't like to be paid. Murphy snatched the crisp new $10 bill and tore off to the nearest beanery.

Shortly after this brush with starvation, he attended Brown University, graduating with the class of 1911, in which year he resumed his fruitful association with Doctor Lucas, Director first of the Brooklyn Museum and subsequently of the American. It was Doctor Lucas who indirectly sealed his fate as a lifetime investigator of oceanic birds by promoting a sea elephant expedition supported by the two Museums.

Murphy was exceedingly anxious to make this trip, particularly since it offered the romantic attraction of several months aboard the whaling brig *Daisy*. At the same time, he was in the throes of an affair of the heart and very much wanted to get married. His fiancée decided that there was no reason why he shouldn't do both. They married and honeymooned in Dominica and Barbados, at which point Murphy kissed his bride goodby, boarded the *Daisy,* and set forth to court the sea elephants. All his scientific work was, of course, incidental to the skipper's main interest — oil. Murphy pitched in as one of the crew, helped capture 27 sperm whales for commercial purposes, and was in turn helped to collect sea elephants. These aquatic mammals so fascinated him that he collaborated with artist Charles R. Knight in designing a bookplate using one of the animals for the central figure. But inspiration for Murphy's unique career came from the strange and exciting new birds which he then saw for the first time riding the gales in the historic Roaring Forties.

"Much that is well heralded in nature," he writes, "carries a tinge of disappointment when it is finally found. A few things, on the other hand, seem beyond over-advertisement. When I faced my first big tree in California, expectation sank into nothingness. The feeling was similar when for the first time I watched and heard the dual performance of the Skylark. With a handful of such experiences, in which reality can hardly fail to transcend hope, I would group the sighting of a great albatross at sea."

Although few English-speaking schoolboys fail to make the literary acquaintance of the albatross, with Samuel Taylor Coleridge as master of ceremonies, perhaps fewer still ever live to see one. Yet the bird's fame has always been international and will last as long as man sails the seas. The albatross has been popularly endowed with a great capacity for wisdom. Doubtless his sagacity has been exaggerated, though certainly no more than his wingspread. Of course the latter attribute is unquestionably the most impressive thing of its kind in all Nature, and if an albatross were to give a demonstration in your living room, he would certainly sweep the pictures off the wall. Nevertheless, Doctor Murphy feels that most observers have been too impressed and that eye-measurements shrink under the tape. Eleven and a half feet is as far as he is willing to go. Big enough, you say. Yes, but the modern royal and the wandering albatrosses are only half the men their daddy was. The fossil ancestor, now unhappily extinct, was just about twice that size. Incidentally, it might be said here that albatross avoirdupois falls far short of the wingspread so that the Ancient Mariner probably suffered no undue muscular strain on his neck. At most he toted a mere fifteen pounds or so.

One gathers from the punishment meted out in Coleridge's poem that superstition operated toward the conservation of the species. But, however profound may have been the seafarer's dread of burning witch's oils and "throats unslaked, with black lips baked," it did not prevent those who manned the windjammers around Cape Horn from fishing for albatrosses. With salt pork for bait these hearties hooked the bill of many a bird of good omen, hauled him on deck, and made short work of him. Albatross plumage yielded feather rugs. The webbing of their feet supplied tobacco pouches, and their long, tubular bones made excellent pipe stems. The flesh, described as "sweet but not firm," was, of course, consigned to the cook's galley.

Among other engaging oddments concerning these prophets of the deep is the fact that, with supreme nonchalance, they preen their feathers and even scratch their heads while flying into the teeth of a howling gale. They can fly astonishing distances and still find their way back to the proper nesting grounds, although one particular, and ornithologically immortal, albatross was blown off his course and wound up in a gannet colony where he remained, among complete biological strangers, for a period of 34 years. He was apparently hospitably received by the gannets, though how far that hospitality extended during the mating season is unfortunately not recorded.

Expeditions

The same year that Murphy cruised southward on the brig *Daisy,* found Mr. and Mrs. Rollo H. Beck leaving San Francisco on the first leg of the Brewster-Sanford Expedition to collect birds of the sea and shore throughout South and Central America and the Antilles. The couple did not return to the United States for five years. During the interim these intrepid field workers collected, often at the risk of life and limb, the greatest assortment of marine birds from those regions ever brought together in one museum. It was not until the Brewster-Sanford collection came in from the field that scientists began to suspect sea birds of dwelling in a world apart. As the collection was sorted and catalogued, it became apparent that a new and distinct ornithological vein had been opened and that a special worker was needed to follow its course. Murphy, his natural feeling for the subject whetted by the whaling venture, was an obvious choice. He became the Museum's first Curator of Oceanic Birds.

Vast though this collection was, it could scarcely be considered complete, and Murphy was soon at sea again, bound for the Peruvian coast, where he investigated the remarkable guano birds discussed in his article last month. After four years spent working up his new collections and fitting them into the Brewster-Sanford series, he combed the northernmost parts of Ecuador and, in 1924-25, its Pacific coastline. These expeditions rounded out the field work prerequisite to writing his *Oceanic Birds of South America,* that monumental two-volume work which stands today as the latest word on the subject.

Perhaps more than any other man, Doctor Murphy has made us see that [illegible] colored, we would see currents, lay- [illegible] surrealistic manner. But it is the surface water, and in particular the surface water surrounding South America, [illegible]

South America is the world's wettest continent, being drained by a surprisingly intricate network of rivers which carry a wealth of minerals down into the encircling sea. Drawing upon the inland soil, these coastal waters produce a liquid medium favorable to the growth of an organic life, consisting mainly of algae and unicellular animals, which comes into being directly or indirectly through the photosynthetic action of the sun's rays. These invisible mites ("the insects of the sea") furnish food for slightly more complex animals, which are devoured by small fish and other water creatures, which in turn fall prey to the birds.

Oceanic ecology is, therefore, a neat summing up of land ecology, simplified by virtue of the smaller number of interrelationships involved. The biologist specializing in land creatures is often forced by the sheer mass and complexity of his material to concentrate on an unstartling though important minor relationship within the huge framework of the whole. Meanwhile, Murphy can embrace the shores, seas, and waterways of an entire continent. Owing to an extraordinarily lucid literary style and the natural tendency of his subject matter to fall into clear-cut categories, he can grip the imagination and teach us a great deal about how things work in Nature. For if you have mastered the fundamentals of the oceanic way of life, you are well on the road to an understanding of the general pattern of biological existence.

Adaptation and environment

The various currents which wind invisibly through the sea, differ markedly in temperature, among other things; and since lower organisms generally have very little resistance to changes in temperature, each current supports its own peculiar range of life. Naturally, when this base of the ecological pyramid varies, the entire superstructure must also vary. Thus, particular species of marine birds rely for their subsistence on particular oceanic currents and will follow those currents wherever they lead, no matter how far that may be from their original breeding grounds. And to venture outside that current means death. It need not be elaborated here, but the reader can perceive that this situation is affected by winds, rainfall, coastal mountain ranges, and all other [illegible] factors. The [illegible] —and Murphy's chief contribution to science—is that he demonstrated once and for all that birds of the sea are truly marine fauna having no connection with the land, except seasonally as a breeding place, and that they are as native to the open water in all other respects as the fish they eat.

Murphy's own colorful phrase, oft quoted, may bear repetition here. He describes the birds as bound like peons to their own special type of surface water. Of the 183 species studied in the course of his quarter-century of inquiry, not all are strictly sea birds. They are divided for purposes of classification into in-shore, off-shore and pelagic, each term locating the progressive distance from land. The fundamental principle, nevertheless, holds true. Each bird is a fisherman and each one specializes in a particular set of sea creatures inhabiting a particular type of surface water, and each is an instrument designed for the purpose.

In short, the oceanic birds of South America represent 183 different ways of dealing with particular phases of the essential environment which begins with sunlight acting on the leached mineral deposits of the land. Every organ and attribute of each one of the species results from the shaping, through centuries of selection, of organic material designed for a special task. Life in or near the bounding deep has developed some of the most efficient wings known to Nature, such as those of the booby[1] (who can catch a flying fish in mid-air), the frigate bird[2], and the albatross. It has also developed some of the least efficient. A number of its creatures have astonishing powers of vision. Others are woefully nearsighted. Some are excellent swimmers. Others would drown if they dropped accidentally into the element that furnishes their livelihood. And so it goes.

Compare the penguin with the albatross sketched above. He cannot fly a stroke. Nature made him, instead, a heavy, well-insulated torpedo, whose myopic eyes would be useless to the high-soaring albatross but which are nevertheless excellent for catching fish not only under water but under ice as well.

Like the royal and wandering albatrosses, the emperor penguin holds a world's record. He easily outweighs all other sea birds, sometimes topping 90 lbs. But his fame does not rest on this alone, for he is the most human of our feathered friends and is the basis of the stylized cartoon penguin known to everybody. For many years now he has been the subject of jokes about formal dinner jackets. He smokes cigarettes on the advertising pages of our magazines and has well-nigh superseded the Eskimo's igloo as a symbol of extreme cold.[3] It is true that he marches about on two legs just as we do, but not always. In fact, he moves faster on all fours and, if really pressed, will propel himself over the ice using web feet and seal-like flippers. Yet his generally upright posture and his nearsighted affability toward human visitors make it easy to forgive Anatole France's good Saint Maël, who was slightly snow-blind at the time, for his error in baptising the penguins. The birds so interested the satirical author of ***Penguin Island*** that he once remarked that, whatever his interests might seem to others, his sole aim in life was to investigate the ways of penguins.

And certainly they merit the attention of our most competent observers, for despite their immense popularity and their prominence in the symbolism, folklore, and literature of many lands, very little is known about their way of life. Doctor Murphy hopes the future will see a whole covey of ornithologists loosed on the widely distributed kingdom of the penguins in order to study their social organization and habits which, from the little that has already been verified, seem both highly complex and extraordinarily delightful.

As in the case of the albatross, man has overestimated the penguin's wisdom. He doesn't seem very bright and indeed lacks the cerebral development to cope with any really intricate problems. Of course, he can be taught, and in spite of a natural inclination calmly

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[illegible]

[illegible] penetration of the cool Humboldt Current, which [illegible] to ignore mankind, soon learns to flee in consternation after his indifference has resulted in a few massacres. There is, however, no way for this conditioned response to achieve the rank of species behavior. Yet they so resemble man that in our fulsome conceit we will probably go on attributing our capacities to them. And the charm of the penguins will certainly remain. Generations of sailors and naturalists have delighted in watching them go belly-whopping in the snow on their portly white shirt-fronts which, incidentally, are believed to be less conductive than the black feathers and hence keep the bird warmer—scarcely one of the recommendations of our draughty boiled shirt. Like some mammals, penguins sleep either upright or lying down. And it may be that they actually swallow pebbles for ballast! Since they lack gizzards, no better functional explanation has yet been offered.

Pebbles, in fact, are quite important in their social life. Many penguins have an instinctive urge to cuddle eggs —anybody's eggs—in a crevice formed by their webbed feet and under-bellies. If no eggs are available, pebbles or rather smooth stones will do, or even suitably shaped chunks of ice. But it is in the courtship proceedings that pebbles become indispensable. Penguins, in common with many other birds and animals, cannot distinguish between the sexes and must select a mate by trial and error. However, "birds in general," Murphy writes, "seem to be more dependent than mammals upon a fixed order of reaction leading toward any essential physiological function."* Accordingly, the male penguin must find a way to his lady's heart by a series of devious maneuvers which become all the more necessary since he is, as often as not, in somewhat the same predicament as the suitors of Charley's Aunt. Staring out of his myopic eyes at another of his kind, of unknown sex, he finds a pebble and solemnly places it as an offering at her (his) feet. The astonishing thing is that the pebble sequence seems to have gone the way of our own more elaborate rituals. So much so that the stone has become purely symbolical. It is quite subordinate to the gesture itself, and the penguin suitor may simply go through the motions and place and an *imaginary* pebble at the other bird's feet. The latter may show indifference (in which case it is at best an unresponsive female) or fight (in which case it is probably, but not certainly a male). One really feels sorry for these victims of gonadal secretion attempting to respond obediently to Nature's demands under such confusing circumstances.

There is an unemployment problem among penguins which serves to further their resemblance to ourselves. These semi-outcasts are, however, not victims of capitalism's notorious cycles. They fully participate as rugged individualists in penguin economy, which consists largely of gobbling up squid and similar cephalopods, their unemployment being of a social rather than an economic nature. The unemployed are "bachelors," which term when applied to penguins, includes both sexes. Some writers call them "rogue penguins," others "hooligans," which should give some idea of their disruptive influence on their happily married brothers and sisters. Apparently they are always lurking about, ready to kidnap somebody's egg or chick, and more than anxious to fight a pitched battle for the privilege of cuddling same. Although this survival mechanism assures the proper asylum for the community's orphans in a bitterly cold climate, it has been so elaborated that chicks not infrequently freeze to death while two perfectly strange adults, one or both of which may be rogues, battle for its possession.

Penguins are terrific fighters, particularly during the brooding season. This propensity has given rise to one curious and highly amusing custom among king penguins for which no one has yet ventured an explanation. The idea more or less resembles the lowest comedy act still extant on our stage and screen—the bathetic slapfest. The birds gather in the form of a circle, each cuddling an egg, and go to sleep standing up. One of them awakes and, unaccountably, rouses his neighbor with a resounding belt of his flipper. The latter retaliates with a whacking "back-hand" and instantly the entire circle is transformed into a Donneybrook Fair—shillalahs, in the shape of lean blue flippers, clouting in all directions. Then the free-for-all subsides as suddenly as it started. The penguins remain stationary throughout, seldom losing hold of their cherished eggs, and go back to sleep again, apparently the best of friends.

Champion of them all is the em-

Continued on page 64

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*With the albatross it is good form to bow elaborately during courtship. If a man venturing among them at this time bows to an albatross, he stands a good chance of having the compliment returned.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 64.

1. What two insects has man domesticated?

2. What gesture could you make to an albatross during the courtship season and expect to have the bird return it?

3. It was used as a bullet against British troops in India; when worn around the neck it keeps off thunder; and it is of special interest to persons born in January. What is its name?

4. A soldier has three pets: a canary, a cat, and a turtle. Which would stand the best chance of surviving a gas attack?

5. Penguins are conspicuous among birds for their excellent vision and can distinguish their mates even when they are mere specks in the sky.

True........ False........

6. Ants are sometimes gem-miners.

True. ...... False........

7. The greatest wingspread in the world belongs to

(a) The albatross

(b) The eagle

(c) The ostrich

8. One of the following is known to have lived from 1766 to 1918; check which:

(a) A Sioux Chief

(b) A tortoise

(c) A penguin

9. What island within 21 miles of North America and two and a half times as large as the State of Rhode Island has been privately owned for 260 years?

10. It came into being largely because of a single animal; it promoted human understanding; and it may be called the Indian's greatest invention. What is it?

YOUR NEW BOOKS

LIFE ON OTHER WORLDS ● AFRICA ● HISTORY OF JEWELRY
BIRDS ● RACE AND RACISM ● WHY MEN BEHAVE LIKE APES
WATERHENS ● PLANS FOR GARDENS ● MICROSCOPIC WORLD

RACE: Science and Politics

by Ruth Benedict

Modern Age, $2.50

WE [illegible] these days [illegible] the last decade [illegible] completed.

[illegible] and the voices of [illegible] raised against [illegible] of ever more incredible variations on the racial theme. Myth-making enjoys a greater popularity than myth-breaking.

In this closely written, admirably reasoned book Professor Ruth Benedict takes race and racism apart, examines what [illegible] their history and explains their vogue in terms of social, economic and cultural patterns. Her significant contribution is the [illegible] between race and racism. Race is a legitimate field of [illegible] known. Racism is a dogma developed by a number of non-scientific and inspirational [illegible] to social, economic and political conflicts. The fallacy lies in supposing that the scientific body of knowledge about race supports racism. It doesn't. Racism is an intolerance, a shibboleth of the times which has been made a convenient tool for more basic struggles. In a modern guise it is the old intolerance of the in-group for the out-group. But in this age of science it follows contemporary patterns by adopting a pseudo-scientific learning. Every manufacturer with a line to advertise knows that one.

This book should be read, it should be digested, and its truths should strengthen our democratic faith.

H. L. S.

5000 YEARS OF GEMS AND JEWELRY

by Frances Rogers and Alice Beard

Stokes, $2.50

THE [illegible] of [illegible] new books [illegible] distinct from gems [illegible] Kunz, so this work on the history of jewelry making and wearing through the ages has a place unfilled by other gem books. The authors have previously published works on glass and communications and water and now turn their attention to another [illegible] appropriate to a popular treatment. The book begins with the first glimmerings of prehistoric man's interest in pretty pebbles, carries on through Egypt, Greece and Rome, medieval and Renaissance Europe, and spreads out in chapters on seventeenth, eighteenth and nineteenth century jewelry. There are many myths and anecdotes retold here that make it interesting reading. Another chapter tells of the development of jewelry in the United States and traces the history of two of the better-known gem dealers. In the course of this recital something is told of the technical aspects of jewelry manufacture as it is practiced today. Cutting forms, synthetics, imitations and doublets are described.

The third section deals briefly with the gem stones themselves. The book is illustrated with many pen and ink sketches, and halftone plates, many of them of objects in the Metropolitan Museum. They are only there as cake frosting, however, for there are few references to the illustrations in the text.

It might be suspected that the authors of books on such diverse subjects are only assembling information published elsewhere and rewriting it in an interesting and readable fashion giving a novel atmosphere and approach to the subject. If this is so, then it is well and interestingly done. However, there is little new information and the third section contains a number of mistakes. The remainder is very acceptable as a handy, brief and interesting history of jewelry making and wearing through the ages.

F. H. Pough

BEYOND THE SMOKE THAT THUNDERS

by Lucy Pope Cullen

Oxford, $3.00

EARLY in this century a rich deposit of copper ore was discovered far up in Northern Rhodesia. Only twelve years ago its exploitation began. Just as he came upon the outcrop, the first prospector had shot a pine buck, so the mine became known as the Roan Antelope. If you want to know the devious way by which the copper was located, what life is like in a new African mining camp, and lots of strange facts about Rhodesia, read Mrs. Cullen's book.

She spent six years at the mine, and kept open eyes on everything around her. The strange behavior of white people and black, especially native servants, is discussed with humor and understanding. The animals of the bush, and those kept alive as pets, are described most sympathetically. Think of trusting the judgment of a tame turkey as to mushrooms safe to eat! The "turkey buzzard" of southern Africa is, of course, a ground hornbill, which can become a most amusing dooryard fowl.

The "Smoke that Thunders" is Victoria Falls, north of which Mrs. Cullen spent most of her time. But from Southern Rhodesia, too, she gives a splendid account of a private game reserve belonging to the extraordinary Mr. Robins. Would that Africa had more like him, and that his original method of warning elephants to depart were more widely used!

Even a naturalist who knows Africa will read this volume with pleasure and profit. But it should appeal most of all to housewives who think they would enjoy life in the wilds and to secretaries who have dreamed of marrying the boss in some [illegible] romance.

James P. Chapin

THIS LIVING WORLD

by C. C. Clark and R. H. Hall

McGraw Hill, $3.25

WHEN is a textbook not a textbook? It rarely happens that a textbook is so planned, written and illustrated that it bridges the wide gap which exists between a textbook and popular nonfiction. This book was written as a text for a college course in science. Along with its companion volume *This Physical World*, now in preparation, it will fill the need for good textual reading for the newer type of college course on science for nonscience students. A study of this book proves it to be very suitable reading for anyone interested in obtaining a good introduction to the world of science.

One senses that the authors have tried to do something different. The easy, fast-moving narrative style of writing combined with accuracy of data and a wealth of illustration makes the book a delight both to eye and mind. This book is an attempt to "present in a form which combines accuracy with pleasant reading, the gist of modern knowledge about the living world, with special reference to the physical development of man and the structure and functioning of his body." The authors have been successful in attaining this end.

Beginning with a discussion of the physical environment which supports life and the general characteristics of living things, the authors continue with an account of the development of life in the geologic past. Then there follows a treatment of the complex physical organization and functioning of the human body. Here is a book on the science of life written for man which places the accent quite correctly on man himself. Wherever possible the authors have been wise enough to introduce the different topics by first referring to common knowledge and then proceeding to material not so generally understood. Anticipating the possibility of the desire of certain readers to delve more deeply into the mysteries of life, the authors have added excellent annotated lists of references at the end of each chapter.

The authors are to be complimented on their timely choice of illustrative material. The photographs are, for the most part, new and very aptly suited to the text. The excellent drawings and charts by Louise Waller Germann leave nothing to be desired. All in all, *This Living World* does complete justice to its title. It has no new contributions to make to the science of life, but the authors have succeeded in their plan, namely, to make the science of the living world a living thing for the layman.

JOHN R. SAUNDERS.

THE MICROSCOPIC WORLD

- - - - - - - - - - by Frank Thone

Messner, $3.00

DOCTOR THONE has written a very readable and interesting survey of the teeming community of invisibly small organisms which permeate all of our environment. The material is well balanced and organized so as to give the reader a reasonably comprehensive picture of a vast section of the living world. The strange facts, curious animals and plants described here should indeed stimulate almost anyone to delve further into the lives of our unseen neighbors whose activities have at times so profound an effect upon our own lives.

The first chapter discusses the microscope itself, the window through which we must look to examine the microcosmos, the second a brief history of the subject, the third a general review of the microscopic animals and plants with some excellent definitions of terms. From the third through the twenty-first, each chapter is devoted to the exposition of some particular aspect of microbiology. The twenty-second and last deals with recent advances and research now in progress. This is in some respects the weakest chapter in the book as it is largely devoted to a single piece of work, Doctor Regnier's attempts to produce germ-free guinea-pigs. However, as the author writes, "So extensive are the various fields and so numerous the research workers in them that it is obviously impossible to give in so limited a space a comprehensive picture of original investigations now going on in microbiology."

The book is illustrated by numerous photographs, including a number of microphotographs, which range through the whole gamut of quality from the excellent as Doctor Roemmert's of a heliozoan on page 124 to the downright bad as the yeast cells on page 172. It also seems a bit misleading that some of the photographs which picture enlarged glass models rather than the actual organism are not so indicated.

JOHN C. ARMSTRONG.

WHY MEN BEHAVE LIKE APES AND VICE VERSA

- - - - - by Earnest Albert Hooton

Princeton University Press, $3.00

AMERICAN anthropology has been considerably enlivened in recent years by a series of books from the witty pen of Professor Hooton, who has never hesitated to be humorous where dull solemnity might have served.

The present work is devoted to the thesis that behavior and organic structure are intimately correlated. No claim is specifically made that behavior is causally linked with variations in anatomy, but rather that they are "co-terminous." If I understand correctly, this means that the organism tends to acquire special behavioristic patterns more or less simultaneously with anatomic deviations. Thus behavior and structure evolve *pari passu* but independently. There are, however, hints that Hooton is prepared to go further in linking body and mind.

The field which Hooton surveys for evidences of his contention begins with the primates, passes through the various stages in the evolution of man, embraces the modern human races, and ends with a consideration of the individual. In this last, he presents a masterly summary of Sheldon's technique for the classification of variations in body build.

Interwoven contrapuntally with this major theme runs a secondary one which has appeared in former books. Society is only as good as the population that comprises it. To neglect the biological heritage of the nation, to fail in preserving and improving its quality, to resort to sociological panaceas instead of selective breeding spells doom for the nation. As part of a concerted research for the understanding and improvement of society, Hooton envisages the study of behavior and structure as an important foundation stone.

H. L. SHAPIRO.

THE BOOK OF GARDEN IMPROVEMENTS

- - - - - - - - - - by Walter Brent

Chemical Publishing Company, $2.50

MOST books that are written on the subject of gardening give instructions for planning and building. This new one, *The Book of Garden Improvements—Over 1000 Ideas and Plans for Amateur Gardeners,* reverses that procedure by giving detailed plans whereby the old garden can be enhanced by remodeling.

The author, an Englishman, has also indulged many times in the giving of advice to builders of gardens. He has written a number of books and for years has edited garden magazines. It was the author's custom, whenever possible, to travel about the English countryside so that he might discuss gardening problems with their various owners. Since the more frequent questions which were asked him had to do with the improvement of gardens already established, he decided to write this book as an answer to such inquiries.

Even though the English gardens are under consideration here no doubt gardens, whether English or American, look just as uninviting if the pergola has no reason for being, the walk be too puny for the size of the garden, or a plant which was intended for a three-foot space grows to a seventeen-foot size. Undoubtedly many of the suggested plants are species that respond best to English climate and many Americans may have difficulty in reckoning the cost of building materials since these are estimated in so many pounds and shillings instead of dollars and cents. But the rules given for making, say, an ornamental wall, trimming a hedge, making a flagstone walk, sunken pond, attractive fence, pergola, trellis or gate, will not vary much whether it be for this area or for areas abroad.

The suggestions given are very definite, such as, "The minimum width for a turf edging is 12 in.; if narrower you can't mow it with the lawn mower," or, "no path should be narrower than 2 ft. 6 in.; otherwise it tends to lose all meaning as a path; it looks like a track!"

The book is profusely illustrated with line drawings, black and white photographs (which are not too clear at times), fifteen color illustrations (of the seed catalogue type) which are rather effective in showing formal garden designs. In fact, if you have become tired of your garden you may find help here among the many hints given for the improvement of nooks, retreats and vistas which do not satisfy your artistic sensibilities.

FARIDA A. WILEY.

THE ROCK BOOK

- - - by Carroll Lane Fenton and Mildred Adams Fenton

Doubleday, Doran, $6.00

THE geological account contained in *Our Amazing Earth* written by Doctor Fenton two years ago is supplemented by this latest work on more restricted aspects of the science. First the building particles, the minerals, are discussed. Some of the more important ones are described, the uses and best known occurrences listed. From the minerals, the authors then go to the processes by which rocks are formed, beginning with the igneous rocks and the various types of igneous bodies, making their descriptions clearer and easier by means of the minerals which have already been described.

This same process is followed in preparing the way for the sedimentary rocks, the manner of their formation and the various kinds of sediments, and resultant rocks, then the metamorphic processes and the metamorphic rocks. It leads to a clear and good understanding of the principal geological processes, the structures of the earth's crust and the processes by which they were made.

A fine popular bibliography and collection-suggestions conclude the book. The plates are excellent and the color plates of minerals, of which they are a disproportionate number, are probably the best that have been published so far. A few rock pictures in color would have rounded [illegible] are found in Ceylon, Hindustan or Colorado; Colombia, Africa and Russia are [illegible] crocline is a bluish green . . ." the author pictures microcline crystals in Plate 8 and [illegible]

There are also many misleading statements on mineral sizes, listings of exact [illegible] of some particular specimen under many minerals, taking the place of a statement of the general range, and implying that it is unique, rather than an average for the occurrence. The remainder of the book is far better. It is unfortunate that these minor, but important, mistakes were not corrected before publication, as they so easily could have been had the manuscript been read by a [illegible]

F. H. Pough

PREFACE TO EUGENICS

by Frederick Osborn

Harper, $2.75

EUGENICS is one of those words that belong well up in Mr. Stuart Chase's semantic series among those phrases whose emotional overtones obscure their fundamental meaning. After reading Mr. Osborn's well-balanced and persuasive introductory chapters in his *Preface to Eugenics* which deal with the interrelations of birth rate, heredity and environment in shaping the present and future character of our population, any lingering doubt on the wisdom of a sane eugenic policy must inevitably vanish.

Scientists, like other human beings, are prone to exaggerate, especially if they feel that they have a message that other members of their co-fraternity are too blind or too dull to see. Consequently we have been deluged on the one hand with minatory literature intended to awaken horrid fears that our biological heritage is rapidly degenerating and, on the other, with assurances that everything will be all right as long as some special environmental reform is adopted. For the most part eugenists have fallen into the former category. Mr. Osborn, however, has eschewed either extreme. He has calmly assayed the most significant research on the subject and has arrived at the conviction that both nature and nurture require consideration in a sound population program. In this common-sense view he oc[illegible]

But Mr. Osborn is not content with [illegible] decidedly optimistic that existing social agencies can easily be developed into an effective mechanism for the improvement of our population.

Preface to Eugenics represents the mature thought of a profound student, without being difficult to read. It should, of course, be on the list of everyone seriously interested in the welfare of our population. But it is more important that those who have distrusted eugenics read it.

H. L. Shapiro

JOHN AND WILLIAM BARTRAM

by Ernest Earnest

University of Pennsylvania Press, $3.50

IN company with the increasing interest in the influences which have led to our present American pattern of life is this absorbing biography of the Bartrams, father and son, botanists and men of letters. It is an analysis of the background of eighteenth century Philadelphia which made possible the scientific and scholarly pursuits of these men and of the influence which they had upon subsequent life and letters. Through his explorations of the eastern United States and collections of new plants from colonial America, the father, John, not only increased knowledge of the plants of this continent but completely altered the fashion in gardens. Both father and son wrote of their travels, but the latter, with more romantic imagery, had a more important influence upon literature, notably that of Coleridge and Wordsworth.

For a most interesting picture of the small world of the eighteenth century, in which almost all the important men, both in Europe and colonial America, knew each other, this is recommended reading.

J. W. Thompson, Jr.

A WATERHEN'S WORLDS

by Eliot Howard

Cambridge University Press, $2.50

THE waterhens (*Gallinula chloropus*) of which Mr. Howard writes are his near neighbors. For 29 of 30 years their kind has occupied a third of an acre pond beside his English home. Given the opportunities offered by this intimate association, it follows that Mr. Howard has penetrated far into what he calls the "waterhen's worlds." In this volume he presents the results of his studies of the worlds of sex. Beginning early in February, when the birds become sex-conscious, he follows the development of their family life from the first evidence of courtship to the dismissal of the young.

The worlds of territory, of sex, with the platform as a stage for its manifestations, of the nest and eggs, of incubation and treatment of the young are reviewed with sympathetic insight and made real by George Lodge's fine drawings. The bird's [illegible] activities are [illegible] with [illegible] so keen one might well believe that through prolonged association Mr. Howard had become a waterhen.

In the following chapters it is shown that the phenomena of the nesting season, while largely the outward manifestation of internal sexual conditions, may also be governed by environmental associations. Thus with the laying of the eggs and [illegible] of incubation there is a cessation of sexual intercourse and dissection would have shown an accompanying decrease in gonadial activity. But there was a male who, during the absence of his mate, resisted the advances of a strange female so long as he remained on the territory with which his wife was associated. He yielded, however, to the intruder when they met in other surroundings, thus indicating that he was influenced by external rather than internal conditions.

In the final, or explanatory, chapter, entitled "The Becoming," the speculative psychologist seeks his way through waterhen worlds unknown even to waterhens and where we are soon lost in a maze of cryptic philosophy.

F. M. C.

WINGS AT MY WINDOW

by Ada Clapham Govan

Macmillan, $2.50

CHANGING the gender and the century, Mrs. Govan is a modern St. Francis of the Birds. She does not preach to them: she lets them preach to her. Out of illness and sorrow her birds led her to health and happiness.

This book is for bird lovers, whether amateur or professional. It is also full of human interest; people who start it not knowing a robin from an oriole, won't lay it down. It combines the power of a soul to conquer against odds, with the incomparable power of the birds to cure. And it adds for good measure original data of how to attract, feed, and care for birds around one's home. No professional conservationist could write a more winning or a better informed plea for bird protection. Mrs. Govan in her simplicity, her affectionate humor and her vitality, can herself hardly realize the value of her work. First, she learned to bring the birds to herself. Now, her book will bring others to the birds.

Beside her home she counts 300 fox sparrows, and once 164 evening grosbeaks. She supplies 290 pounds of birdseed in four months. She cuts yarn for nests so generously that 700 pieces are flown off with in one morning. She watches the courtship of the purple finch. Her birdbanding ventures make good records as well as good descriptions of how to handle trapped birds. Her imaginative references to birds' facial expressions run away with her for a bit, for, while birds can erect the feathers on various parts of their heads, they are incapable of facial expression as we know it in man or dog.

Dorothy Bayley's drawings are on a par with the charm of the whole book.

Grace E. Barstow Murphy

LIFE ON OTHER WORLDS

- - - - - - - - - by H. Spencer Jones

Macmillan, $3.00

ARE there inhabitants on Mars? What is the probability of life on Venus? Of the thousands of questions asked by visitors to the Hayden Planetarium these are among the most numerous. It is a natural curiosity that inspires such inquiries, and members of the Planetarium staff make every effort to provide answers whenever possible.

Life On Other Worlds, by H. Spencer Jones, Astronomer Royal of England, offers Mr. John Q. Public the most comprehensive and intelligent discussion of this problem that we have yet discovered. As a scientist of high standing among his contemporaries, Doctor Jones tackles the problem in a most logical manner. After painting a word picture of the universe as it is known today, he reviews the conditions necessary for life as we know it on the earth. He discusses the methods by which the modern astronomer studies the planets and tells in detail what is known of the physical conditions on these neighbor worlds.

He explains that Venus may be in a condition somewhat similar to the earth many hundreds of millions of years ago. This planet may some day see the development and evolution of life as it has evolved here. As for Mars, he suggests that some forms of plant life may exist there. Aside from these planets, he argues that life as we know it cannot exist elsewhere in the solar system.

Life On Other Worlds provides lively reading and can be relied upon as the last word on a question that is of interest to scientist and layman alike.

ROBERT R. COLES.

THE TETRAPOD REPTILES OF CEYLON

- - - - - - by P. E. P. Deraniyagala

Colombo, Ceylon: Colombo Museum, Rs. 10/-. London: Dulau & Co., Ltd. 15/-.

THE first volume of this comprehensive treatise constitutes the fourth volume of the Colombo Museum Monographs on the Zoology of Ceylon, and is published by the Government of Ceylon. It deals with the testudinates and crocodilians, while the second half of the work will be devoted to the lizard-like forms, including the limbless skinks which "although not literally tetrapodal, retain vestiges of the limb girdles." It is provided with a systematic arrangement of the Ceylon reptiles with which the author deals, a glossary of scientific terms, indexes of native, English and scientific names and a nine-page bibliography. Each species is described in considerable detail, attention being given to osteology, ontogeny and habits. Thus it is not only a valuable reference work for the specialist, but instructive reading for the amateur. The 412 pages of text are generously interspersed with drawings and photographs by the author.

AMERICAN WILD FLOWERS

- - - - - - - by Cecile H. Matschat

Random House, $0.50

NINETEEN of the 264 familiar color plates which orginally were issued in *Wild Flowers of New York,* and later appeared in *Wild Flowers,* are used in this slender volume which is designed to stimulate the juvenile interest in wild flowers. A number of additional species are pictured on the end papers, together with brief comments upon them. The text accompanying the color plates is interesting and written on a juvenile level; the scientific names are relegated to the table of the season of bloom at the end of the book.

J. W. T., JR.

ULTIMA THULE: Further Mysteries of the Arctic

- - - - - by Vilhjalmur Stefansson

Macmillan, $3.50

FOR anyone familiar with Stefansson's published writings of the last three years, this volume comes as a logical sequel. He has such a faculty for accumulating and marshaling facts and data that the research on his preceeding work on Iceland must have yielded him more material than could justifiably be used.

Under the present title we have three main subdivisions. The first, "Pythias and Ultima Thule," reviews all the pertinent facts and suppositions showing whether Pythias the Greek did or did not visit Iceland in the fourth century B.C. As far as the average reader, unfamiliar with the pros and cons of this scholarly problem, can discern, he has exhausted all of the real and supposed aspects of the case. Although Mr. Stefansson offers no very positive answer to this ancient question, there is little doubt as to his own convictions.

The second section, titled "Did Columbus Visit Thule?" is probably of more general interest, for many people must have heard some previous reference to this scantily documented trip to Iceland. Long a controversial question, he has reviewed its historical background, the data on which it was founded, and the attitude of various writers since the death of Columbus. Included is a previously unpublished contribution toward the solution of this problem, Miss Eloise McCaskill's retranslation of the original reference, and her study of a map made by one of Columbus' shipmates. Again, although the reader is challenged to form his own conclusions, there is no doubt as to the author's convictions.

The third part, "Were Pythias and Columbus Right about Arctic Climate?" is a chronological presentation of man's conception of Arctic weather. To most of us, it may be a surprise to learn that there are some observers who maintain that there is no summer season in the Arctic. The reviewer believes that Stefansson has taken these too literally and in his refutation has gone to the other extreme. As he himself hints, the truth is hard to generalize about.

JUNIUS BIRD.

Ultima Thule

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The subject matter covers a wide range, from wild ducks and gorillas to the domestic cat, concerning which readers of NATURAL HISTORY have already had a sample in Doctor Andrews' engaging story of "Lord Jitters," published in last month's issue of the Magazine.

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G. P. PUTNAM'S SONS, New York

THE IMMIGRANT IN AMERICAN HISTORY

by Marcus Lee Hansen

Harvard University Press [illegible]

T[illegible] undated a comparable area as in America; and consequently hierarchies within hierarchies of great complexity have arisen, based on chronological succession in the settlement of the United States. Entire national groups by virtue of a few years' antecedence in reaching these shores have either assumed or had airs of superiority [illegible] different origin. Those of colonial descent feel a subtle but pervasive superiority over all the immigrant stocks reaching America after the Revolution. The Irish and Germans who settled in the United States in the middle of the nineteenth century had to endure native prejudice, but in turn scorned the Hungarians, the Italians and the Poles who succeeded them. The Jews of pre-Revolutionary families, if they have not already been absorbed in the general population, consider themselves aristocrats, and the German Jews of the fifties rank themselves above their Polish and Russian cogeners of the eighties and nineties.

The ramifications of this mild form of national lunacy are too complex, however fascinating, for a brief review of a book which I have found to be an unqualified delight. I mention them only because a species of this attitude has blinded our professional historians to the part which the nineteenth century immigrant has played in American life and which Professor Hansen in this posthumous account of the immigrant in American history was one of [illegible] tory. He has characterized the distinctive qualities of the migration from 1815 to [illegible] colonial immigration. He has drawn a composite picture of the hardships and trials encountered from the casting off of home ties until the establishment of new ones in the New World. The role of the immigrant in the westward expansion, his stabilizing of democracy in the critical years after the Revolution, his contributions to Puritanism by means of conformity and reaction, his gifts to American patterns of culture form topics for discussion. The wealth of material still awaiting patient research, which Professor Hansen outlines in a final chapter, is alone enough to whet one's appetite for a more complete treatment of a sadly neglected field.

I read this modest but illuminating book with a mounting pleasure. It has authority; but what is more, it has a profound significance.

H. L. [illegible]

GEMSTONES

by G. F. Herbert Smith

Methuen [illegible]

THIS admirable text, the first edition of which appeared in 1912, has been a standard of popular reference since that year. Dr. Herbert Smith, however, has produced in this, the ninth edition, what amounts to a new and very much up-to-date book.

As the publishers point out in their prospectus, the scope of the rewritten text has been widened so that its appeal is no longer confined to that section of the public interested in a popular handbook on gems, but may also be used as an authoritative tool by professional gemologists throughout the English speaking world.

What impresses one chiefly is the masterly way in which the great mass of information about gems has been organized so that a given fact or group of facts may be readily found and correlated. The author has accomplished this without in any degree sacrificing the charming lucidity of diction which has characterized his book throughout its eight previous editions.

Such terms as [illegible] synthetic emerald produced by the I. G. Farben [illegible] and "endoscope" (the [illegible] used to differentiate native from cultured pearls) are fully discussed and serve to indicate to what an extent Gemstones has been brought strictly up to date.

The new edition adds about 120 pages over previous ones, but owing to the difference in format and typography, it contains upward of [illegible] words over any previous one. New halftone plates have been added and substituted, and many new and better line cuts explain the letter press. It is unfortunate that the four color plates are not up to the standard of the British Museum postal cards in accuracy of color.

H. P. W.

JEWELS AND GEMS

by Lucile Saunders McDonald

Crowell [illegible]

THIS gem book is unusual in that it tells little about gems, but a great deal about jewels. Here is no dry, scientific discussion of the various gem stones, but rather a fascinating collection of stories, legends and myths concerning jewels. Most of the emphasis of the book is placed upon the gems of the Orient, and some of the most vivid stories are those of Great Moguls of India who must have been very disagreeable people.

The chapter headings, such as "Moonlit Dewdrops," "Thieves in the Garret," "Stone Trees, Kangaroos, and Opals," "The Ruby Kingdom," "Sun Stone and Desert Gem," "Isles of Riches" and so on, give a very inadequate idea of the content, but somewhere through the book most of the gem stones are mentioned, and there's usually an entertaining bit of story telling.

A tremendous amount of research into original sources went into the writing of this book and it would have been interesting if a list of references had been given. The chief criticism of the book is that the author, while well versed in the old literature, lacked the background of science which would have enabled her to distinguish between possible and impossible tales and, much more important, to know what gem was meant by the older writer. Gem terminology has been badly confused through ignorance and dishonest misrepresentation, and the unwary author can fall into a terminology trap, as Mrs. McDonald has done. Her chapter on topaz really describes a yellow sapphire, her "precious" amethyst is really violet sapphire, and so on. It is good reading, but the author is no authority on gem names or relationships. Remember that it is purely a story book, have an authoritative, if dry, gem reference handy, and enjoy yourself with this book.

F. H. Pough

LETTERS

[illegible]

Sirs:

. . . Your magazine is highly prized in our family by three generations of readers.

[illegible]

Upper Montclair, N. J.

* * *

Sirs:

[illegible]

W. T. Shipp, M.D.

Middletown, Ohio.

* * *

To the Editor of Natural History

In your current number you feature an article on Eo Hippus. And what you don't do to Natural common sense let alone [illegible]

[illegible] Knight [illegible] Dawn Horse [illegible] [illegible] Walt Disney should hire Knight for the second edition of *Fantasia*.

Dr. [illegible] we dominies who are supposed to walk around with our heads in the fog allowed our imagination such wild range in theology as the forementioned is in what is supposed to be science, we would be laughed out of the asylum.

I had long intended writing the Museum about their Hall of the Age of Man, and its paper mâché concoctions. Not that I have hopes for any mind who sponsors such nonsense as science, but simply because I shed a tear for the little children who are shown such wrongness.

Not that I expect, but to put one country parson on record as able to see how the Devil operates. I shall pray for you. Do you ever feel repentant?

Cheerfully and hopefully yours,

[illegible]

First Presbyterian Church,
[illegible], N. J.

CATCH A COMET

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

A COMET for New Year's Eve! How fine, thinks the astronomer, amateur or professional. Something new in the sky to watch. It has been 30 years since we saw a good, naked-eye comet. According to the laws of chance, we should have had one before this. Let us make a portrait of this celestial visitor.

Cunningham's Comet should be an interesting object in the sky, and if you search the heavens shortly after sunset around the beginning of the New Year, you will be able to see this luminous giant. Certainly here is an opportunity for those enthusiastic camera fans who thrive on unusual photographic stunts. Shooting such a celestial object is an interesting experiment, quite different from the usual run of picture taking.

Mounting the camera

Because a time exposure will be needed to record a relatively dim object such as a comet, special provision will have to be made to allow the camera to follow the movement of the stars. The heavens appear to revolve around a point in the sky which is a prolongation of the earth's axis of rotation. This point is quite near the Pole Star, actually only about one degree away, which is an inconsequential difference for the business at hand.

In order to make exposures of any duration of the sky, the camera must be set upon an axis that is parallel to the earth's axis and must rotate at the same speed but in the opposite direction. All this may sound very complicated, but actually it is quite simple if you can obtain a motion picture camera tripod with a pan-and-tilt head. The tripod is set up out-of-doors, in a place where the wind won't shake it, with one of its three legs on the north side of the tripod. The north side is, of course, the side toward the Pole Star.

Of course you remember how to find the North Star. Join the two end stars in the bowl of the Big Dipper with an imaginary line and carry it up five times this length until it hits the only bright star in that region of the sky.

Shorten the north leg of the tripod until the tripod head assumes an angle with the ground of 90° minus your latitude. For instance, New York has a latitude of 41°. 90 — 41 leaves 49, which is the angle the tripod head should make with the ground. Actually, 45° would be close enough for our purpose. This angle is easily obtained with a carpenter's level and a 45° triangle. This tilting down of the head of the tripod to the north makes the panorama axis (normally upright) point directly at the North Star. Note that we do not mean to point the camera at the North Star, but a line running straight through the center of the base to which we screw the camera.

Making the exposure

Screw the camera onto the tripod head and swing it to face the comet, using the sky chart on page 8 of this issue of NATURAL HISTORY. This may be something of a trick, with the tripod at such a rakish angle. In fact, it may be necessary to add a small ball-joint to the top of the pan-and-tilt head. If the tripod becomes unsteady, guy it with cord to a stake or two driven into the ground.

Some sort of magnifying sight will be necessary to guide the motion of the camera. A small telescope magnifying 15 or 20 times or a pair of binoculars fastened to the camera will be quite satisfactory.

The camera should be loaded with fast film, the lens diaphragm opened to its fullest extent, and the lens focused at infinity. You may be more comfortable while following the comet if you sit on a chair close to the tripod. When all is in readiness, look into the telescope or binoculars attached to the camera and watch the stars drift across the field of view in accord with the earth's rotation. The effect is much more noticeable at the edges of the field, because there the stars will be passing a stationary boundary.

When a sufficiently bright star comes into the field to be seen easily, wait until it is just about to leave the field of the binoculars or telescope and then open the camera lens. As it drifts out of the field of vision, move the tripod head ever so slowly until the star is brought back into the edge of the field again. When it drifts out, bring it back again with a slow movement of the panorama head. Keep the motion as even as possible by acting as soon as the star drifts out of sight and bring it just back in. Continue this procedure until the exposure time is up. Only the panorama axis need be rotated; the tilt axis must remain clamped.

Exposure of fifteen seconds to two minutes should prove ample with a lens of f:4.5 or larger, if the fastest film is used. Since it is impossible to determine accurately the time of exposure, it will be wise to make several shots, varying the exposure time with each try.

If it happens that the comet can be photographed only during twilight, infra-red film may solve the problem of an overbright sky. Of course a red filter will then have to be used over the lens. In either case the film must be developed for about double the normal length of time to obtain maximum contrast.

A striking picture of the comet will be quite a souvenir to have of this celestial event. Try your luck at shooting this visitor from beyond as it dashes in for a whirl about the sun. It will vanish soon, perhaps forever, into the dark emptiness of space. Even if you don't get a good picture, your hardships while trying will make fine sport.

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Answers to Questions on page 57

[illegible]

[illegible] page 55

[illegible]

[illegible]

[illegible] Often [illegible] an astonishingly formidable opponent on the slippery ice of his home grounds. One ship's record reveals that eight men attempted to capture "the champ" alive. Lashing out with his flippers, the bird dealt bruising haymakers until all eight of his would-be captors were strewn around the ice. He was momentarily subdued when one of them pinioned the terrifying "fists" with a leather strap. Everyone sat down and drew a deep breath. But so did the penguin. The strap burst instantly, and finally they had to truss him up with rope, after which he was hoisted to the deck. Released, he knocked the inquisitive ship's dog cold, sweeping him into the scuppers with one mighty right hook.

Such engaging and illuminating accounts of oceanic bird life are interspersed throughout the species biographies in Murphy's two splendid volumes. The books combine readability and sound science in so nearly perfect a blend that their scarcity would seem a setback to world education. As has frequently been deplored, a mere 1200 subscription copies were printed, two of which belong to President Roosevelt. This leaves only 1198 for the rest of us and it is high time some sagacious publisher took the existing color plates under his wing and balanced the budget.

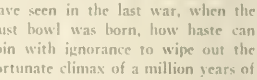
But if Doctor Murphy's influence has been artificially limited in this regard, it has found other outlets. A noted lecturer, he has spread the good word for wildlife conservation all over the country. Many popular articles on the same topic have come from his pen and, as Director of the National Audubon Society for 20 years, he has been active in the promotion and enforcement of beneficial legislation. Nor has he lacked for honors. He and Doctor Chapman, are the only living honorary presidents of the National Audubon Society. He has won numerous medals: The Brewster Medal of the American Ornithologists' Union, 1937; John Burroughs Medal, 1938; Cullen Geographical Medal for 1940. Above all, he has worked unsparingly to the end that mankind may learn to understand not only the birds of sea and land but all of Nature. A few words from him of particularly timely importance are herewith subjoined:

Reprinted from the New York Herald Tribune, July [illegible] 1940

"The people of the United States face today the most pressing responsibilities that any of their living generations has known. . . . We must turn more of our leisure into discipline. Not only our gains but even our needs must flow into armaments. Constructive research that would brighten the future of all mankind must be sidetracked to meet a threat against priceless traditions. The urgent call extends, indeed, out beyond our own gates as far as the most distant victims of unprecedented calamity.

"This is the cause of stern necessity. But, while we throw our strength behind it, let us remember always that the means are not the end. We have no intention of militarizing the guiding thought of our nation to the exclusion of more enduring things. Music will outlive the rattle of machine guns and painting the splotch of camouflage. A healthy countryside, the irreplaceable native flora and wildlife—if we succeed in keeping them—will abide longer than battleships, but, unlike precious paper and canvas, they cannot be saved in the depths of bombproof shelters.

"The conservation of natural resources is never more important than under the shadow of hostilities. We have seen in the last war, when the dust bowl was born, how haste can join with ignorance to wipe out the fortunate climax of a million years of growth. Education must still point forward rather than into the detour. Such wisdom as Americans now possess in the appreciation of undespoiled nature was not learned by men and women; it was, for the most part, implanted in the sensitive minds of the children they once were. This work, too, must go on, not diminished but enhanced. Its cost is relatively trifling but, as an essence of preparedness of the spirit, we cannot afford to see it crowded out. For one day, soon or late, the mists that shorten vision will lift again, and eyes too long diverted must be ready for the renascent brilliance of the view ahead."



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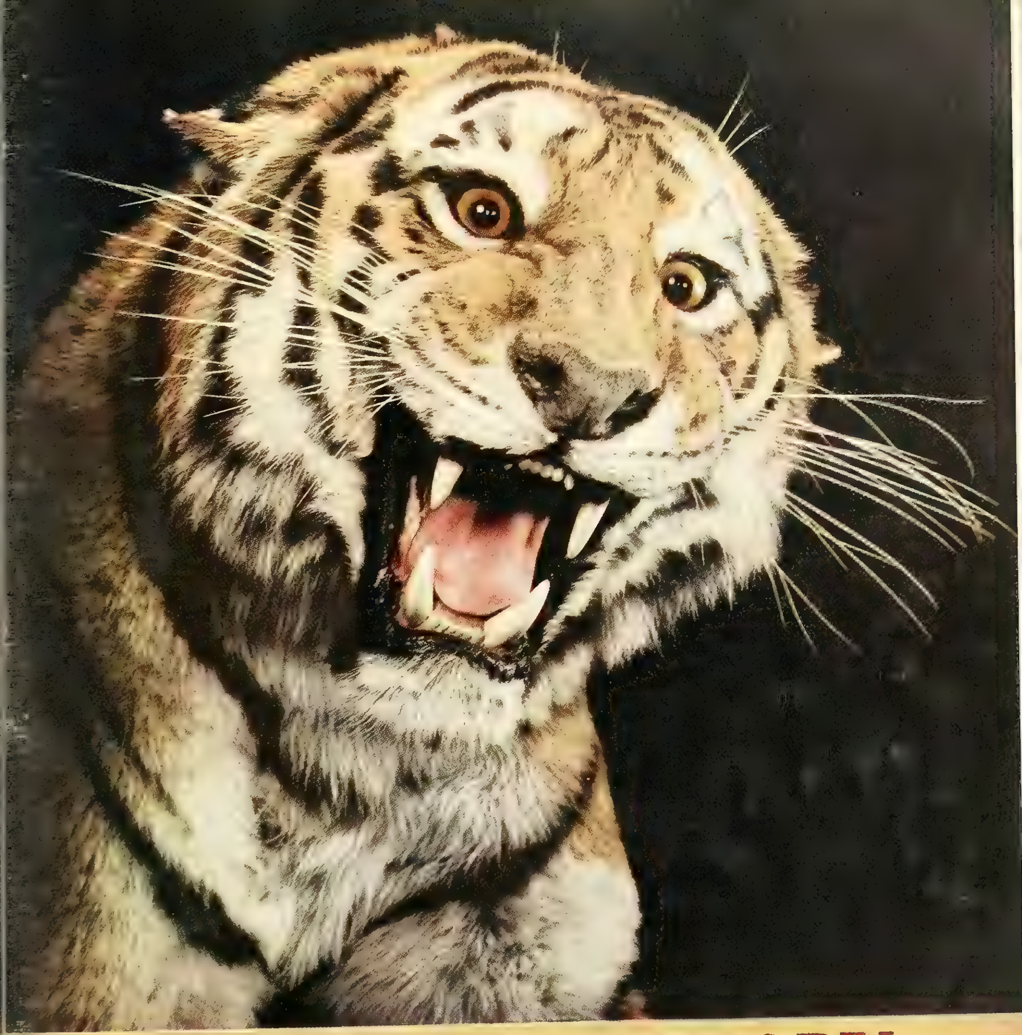

February **NATURAL HISTORY** 1941

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VOLUME XLVII, No. 2

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Natural History

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Above illustration painted by F. L. Jaques from [illegible] Group of Hudson Bay Region in the American Museum of Natural History.

LETTERS

SIRS:

I turned to the December number of NATURAL HISTORY this morning and began reading "Unchallenged Champion," by E. Thomas Gilliard. The story was so fascinating that I read to the end without rising from my chair. It was a marvel of discovery, and at such a price. It is hard to visualize students or easy chair scientists climbing mountains under such hazards as those men endured. . . . One finds only one disappointment in the tale: the failure to find the headwaters of the falls or the gold.

But I had planned to write you before regarding the article on the evolution of the horse in the November issue. There are two questions in the mind of this novice:

1. How can the scientists reconstruct an animal from the small fossilized fragment that he finds? A mere "shinbone or a piece of an ear," seems utterly insufficient material from which to build a horse.

2. How does it occur, admitting the truth of the reconstruction, that the horse has evolved larger than his ancestors? In the case of the elephant, it has been a decrease from the mammoth to Jumbo. Also the dinosaurs have been replaced by much smaller reptiles. Why then has the tiny five-toed "Dawn-horse," Eohippus, developed into the 2200-pound Belgian champion draft horse?

These questions are amateurish, but I am only an inquirer.

(REV.) I. T. HAWK.

Augusta, Ga.

The following information in answer is given by Dr. George Gaylord Simpson, the author of the article on Eohippus referred to:

1. Scientists cannot and do not reconstruct whole animals from a fossil fragment, a mere "shinbone or a piece of an ear." They sometimes can *identify* an animal from a fragment, but not *reconstruct* it. For instance you might find a human tooth and by careful study you could be sure it was human, which is identification, but you could not tell whether the owner was male or female, handsome or ugly, black, white, red, or yellow, or, in short, you could not draw a picture of the person, which would be reconstruction or restoration. As I tried to emphasize strongly,—indeed it was the point of my article—, reconstruction of Eohippus was impossible until virtually the *whole* skeleton was known.

2. It is the rule in nature that animals tend to become larger with the passage of time, not smaller, and the horses followed this rule. There are exceptions, and it is not known certainly why evolution usually makes animals larger, but it is certain that this is a fact. The elephant is not a mammoth reduced in size. In the first place, some elephants are larger than some mammoths. In the second place, the common and largest mammoths were not the ancestors, but, so to speak, the uncles of the elephants. The direct ancestors of the elephants were smaller than the living descendants. The same is true of the dinosaurs and later reptiles. The big dinosaurs were themselves derived from smaller ancestors. They became extinct without leaving descendants. The smaller reptiles that followed them were larger than their own ancestors, not dinosaurs, that lived in the age of dinosaurs.

* * *

SIRS:

We enjoyed the story "Where the Cats Came From" . . .

A. C. BURRILL,
Curator.

Missouri Resources Museum,
Jefferson City, Mo.

* * *

SIRS:

While in the library I was attracted to your magazine NATURAL HISTORY by its beautiful cover design. I liked especially the articles, "Miracle on Wings" and "A Snake in the Hand" . . .

IRA SAMUELIAN.

New York, N. Y.

* * *

SIRS:

I read with interest and a good deal of agnosticism "A Snake in the Hand," by E. Ross Allen, as told to Merle Park Merryday. I have been collecting venom from the water moccasin for a number of years and have been working on the bibliography and actions of the venom. There are a number of rather serious errors in the article:

In the account of Doctor MacDonald there is the parenthetical remark that the antivenin contained enough rattlesnake venom and horse serum to kill a crocodile (page 235). The antigen contains the venom; the antivenin contains none.

Experiments on snake venoms did not begin "early in the present century." The great works of S. Weir Mitchell and his co-workers were published between 1860 and 1897. A survey of the bibliography of Mitchell and Reichert's *Researches Upon the Venoms of Poisonous Serpents* will reveal much earlier work.

On page 238 of the article, this statement is made: "When dried it [i.e., the venom] loses 20% of its weight and appears as white or yellow crystals, which are soluble in water. Cold has no effect on these crystals . . ." This contains two errors: (1) the percentage of water; (2) the nature of the dried venom.

The venom is a mixture of numerous substances: proteins, inorganic salts, water, cells, and cellular debris. It dries in scales or irregular particles, which have a fairly high refractive index (1.558 by my measurements) but are amorphous, not crystal-

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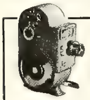

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[illegible] Mitchell and Reichert. Their description follows: ". . . it [illegible] like an aggregation of [illegible]."

The statement as to the water content of water moccasin venom is apparently a [illegible] in the literature. Mitchell and Reichert give the water content as [illegible]. H. Noguchi, in his *Snake Venoms: An Investigation of Venomous Snakes with Special Reference to the Phenomena of Their Venoms*, cites S. Flexner and H. Noguchi as finding the water content 30-50%. However, Wolff and [illegible] give the water content as 75%. [illegible] figure is [illegible] when the fresh venom is dried immediately [illegible] over [illegible]. All these figures are for water moccasin venom; other venoms are quite similar, however.

Mr. Allen states that venom is odorless. H. Noguchi states, "The peculiar odor, often attached to venom, has its origin in the snake itself." This statement is [illegible]. I have always been able to detect a slightly nauseous odor in the venom I have collected. This odor is as described above. The odor is similar to that of egg white.

In view of the numerous errors, I can hardly accept the rest of the article as more than another interesting "snake [illegible]."

Robert V. Brown

Michigan State College
East Lansing, Mich.

Ross Allen answers Doctor Brown's criticisms and "agnosticism" as follows:

(1) Regarding the parenthetical remark in Doctor MacDonald's account of the snake bite, we did not attempt to change the original report of the case. It is true that antivenin is a product made from horse blood after the horse has been made immune to snake venom.

(2) In our article we did not give any date as to when experiments on snake venom began, but referred to work on treatment of diseases, which did begin early in the present century. Study of snake venoms, as such, is a different subject; therefore, I believe Doctor Brown's criticism is not justified in this case.

(3) This is a typographical mistake and should have read, "and loses all but 20% of its weight." Almost every day I answer this question in public on how much water is in snake venom, and our answer is 80%.

Regarding the second part of the third question, I cannot see where we erred in our statement. We have found that the public understands better when you describe venom as "yellow crystals," even though it be granted that dried venom is not crystalline. We have also found that there is a great variation in the amount of water in venoms, and Doctor Brown is incorrect in thinking that all venoms are similar.

(4) We are correct in saying that fresh venom is odorless because at the time we referred to snake venom freshly taken from the snake. I have never been able to find an odor in fresh venom, that is, immediately after the snake has been milked. However, there is a nauseous odor in venom after it has been in contact with air. Venom improperly dried has this odor.

. . . Since it was an article for the public, we tried to put it in the layman's language and did not take up space with uninteresting references and statistics but gave our own experiences as we had them firsthand. . . .

• • •

Sirs:

Your recent article on a sting by a venomous snake has caught my attention . . . Are venomous snakes known to exist in the State of Maine? I have grown up in the popular belief there were none, as have all my neighbors. But your recent magazine issue called to mind something that happened to me about four or five years ago. I saw a snake lying one morning coiled in the shaded roadway under our elms and went to scare him out. He didn't move, which surprised me. He was about twelve or fourteen inches long, of a general brownish color, I think. I took him for one of the adders that are very common here. Just as I stepped in front of him, I heard a faint sound, something like a vibrating "whir." I didn't connect it with the snake till my attention was called to his tail, which looked like two tails. It stopped just as I looked at it, and I could see it was only one, but it must have been vibrating hard and fast, for a spiral of dust was coiling up from the road where it lay. It was unlike any snake tail I had ever seen, the only one that didn't taper down to a fine point at the end. It was about the size of my little finger, looked as though it had been tightly and evenly baled round with wire, with one strand baled over the end lengthwise, so that two bulges like knobs were produced, and there seemed to be traces of more of them coming on either side. I looked at that tail, I think, about two seconds before the snake struck like a flash at my ankle. I jumped back out of the way, after which he fled off into the bushes by the stone wall.

Though I had never heard a snake make a noise before (I'm told they hiss but I have yet to hear it), I thought he must have wagged his tail hard enough to make it whir, and though that was new to me too, in time I forgot all about it. Last summer (1939) I looked at your June issue and saw the illustration of a diamondback rattler. The first thing my eye fell on was the peculiar knobbed tail, and I think my temperature went up ten degrees. My snake did not rattle, at least not what I call a rattle . . . Can you tell me if there is any possibility that this snake was a rattler? If not, then would any of your staff know of a snake that fits what little description I [illegible] . . . [illegible] rattlesnakes supposed to exist in Maine? I had always thought we hadn't a venomous snake for a radius of hundreds of miles. Are rattlesnakes found in New Hampshire? I've been told they are, but can't vouch for the truth of it . . .

[illegible] A. Hardy

Westbrook, Me.

Charles M. Bogert, of the American Museum's Department of Herpetology, answers Miss Hardy's questions as follows:

Many of the harmless snakes in this country, as well as in other continents, vibrate their tails in much the same fashion as do the rattlesnakes. Indeed, we have reason to assume that the vibration of the tail probably preceded the evolution of the rattle, and further, was a factor in its development as an organ used expressly for purposes of intimidating and alarming the enemy. Our larger snakes, in particular the racers, black snakes, and pine snakes, vibrate the tail in such a manner that if they happen to be in contact with dry leaves or even twigs in the underbrush, a noise comparable to that made by rattlesnakes is produced. This may, of course, be construed also as "mimicry" of the rattlesnakes, and may be of real value to the harmless snakes, since we definitely know that certain enemies of snakes will not attack a snake with rattles.

The knobbed tail on the snake observed by Miss Hardy may have been normal, but many snakes lose portions of the tail through accidents of various sorts, and a "blunt tail" is not a rarity on most of the larger species. The State of Maine can probably claim the distinction of being the only state in the United States that has no indigenous venomous snakes. Two records of the timber rattlesnake in Maine were published in 1863, but these have never been substantiated, and the copperhead is known only as far north as eastern Massachusetts. Rattlesnakes are known in New Hampshire, specifically in Carroll and Merrimac Counties. Therefore, we feel quite safe in stating that the snake encountered is quite harmless, despite the fact that it struck in such a business-like manner. Many harmless snakes, particularly young ones, frequently resort to the most impressive displays, but it is entirely bluff, calculated to intimidate the enemy. Usually the wide-spread mouth is closed before it actually reaches the enemy since without fangs, such a "strike" would be ineffectual at best.

[illegible]

THE MUSEUM AND EXPLORATION

OUR EARLIEST ANCESTORS had an impelling desire to find out what lay over the next hill; what secrets were hidden in the primeval forests; what those lands glimpsed through the gray mists across the Arctic Sea, were like. This restless desire to know the world about him sent primitive man wandering to the uttermost corners of the earth.

After the dawn of civilization the same urge to know all the lands and seas sent the Vikings and Columbus to discover the New World. It sent Magellan and De Soto, Lewis and Clark, Stanley, Peary and Byrd and countless others to mark on the map every mountain range, lake and desert and river.

But modern exploration is not the same job that it used to be even twenty years ago. The old days of the Arctic explorer foot-slogging behind his sledge are gone. Exploration has entered a new phase.

The great pioneer lines of discovery have been thrown across the continents in every direction. Today there remain but a few small areas of the world's map unmarked by explorers' trails or where an airplane has not droned about the mountain peaks; only a few small areas whose topographic features are unknown. But that does not mean that there are no new worlds to conquer! It means only that the explorer must change his methods. There are vast regions which potentially are *terra incognita*. Many are mapped poorly, if at all, and some hold undreamed of treasures in the realms of science. To study these areas, to reveal the history of their making, to learn what they can give for education, culture and human welfare—that is the exploration of the present and of the future.

But in order to learn the history of a country one must make collections—rocks and fossils, mammals, birds, insects, reptiles, plants, fish, archaeological remains and specimens of anthropology. All these must come to an institution for study if we are to interpret them correctly and see how they fit into the great scheme of nature. Also they must be permanently preserved. Universities are not equipped to handle large collections; neither are geographical societies. Museums stand alone in their facilities for scientific exploration.

From the very first it was recognized that exploration is the lifeblood of a natural history museum. It brings to the institution new facts for research and publication, new specimens for exhibition and for public education. Some of the greatest expeditions of modern times have been fostered by the American Museum. In 1930 its exploration program reached the maximum with 37 expeditions in the field. Today we have less than ten, but the need to push scientific exploration vigorously is increasing every year.

Since transportation by air and motor has made accessible even the most remote parts of the world, primitive conditions are rapidly changing. Native tribes are disappearing and animals, birds, and faunas are being exterminated with no records of their existence left for future generations. In view of this, it is the duty of the American Museum to carry on explorations and obtain these records for its studies and collections before they have vanished from the face of the earth.

Roy Chapman Andrews

The American Museum of Natural History

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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, Sc.D., Director

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(From a Kodachrome by Charles H. Coles)

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THE MANDRILL as it will appear in the new group now being constructed for the American Museum's Akeley African Hall

SAA COMES OF AGE–Lif

Saa* clung desperately with grasping hands and feet to her mother's shaggy sides as, together with a score of other frightened monkeys, she raced silently aloft by branch and bushrope to hide herself and her child in the very attic of the tropical forest. The leader of the troop, a huge blue-faced old mandrill, had exploded one startled "oomph-a" of warning and the next instant had crashed into full flight through the dense underbrush. A few seconds later he could no longer be heard.

The rest of the band, females with babies, young adults, boy and girl mandrills—all obeyed their common instinct: at the sound of the "Old Man's" savage grunt each sprang for the nearest tree or vine and swarmed into the treetops.

At that moment wild yells burst from the lungs of negro hunters who had stealthily encircled the unsuspecting animals. "Clonk. Clonk," sounded the wooden rattles tied under the necks of two hunting dogs just slipped from their leashes. The dogs quartered the ground beneath the treed mandrills, trying in vain to pick up the scent of the wary old male, already far away.

Two of the hunters fired their guns at climbing animals which had lagged slightly. Others aimed powerful crossbows that discharged deadly little darts tipped with *ne*, the arrow poison of West Africa.

[illegible]

Story of a Mandrill

By G. H. H. TATE

Assistant Curator of South American Mammals, The American Museum of Natural History

Deep within the forests of West Africa lives the most singular-looking member of the whole monkey clan—the gaily-colored mandrill, whose habits the author observed intimately while on an American Museum expedition. The accompanying story relates one of the most crucial episodes in the social life of these fascinating creatures

A mandrill swayed, climbed more slowly and hid in a huge fork. Another crashed instantly to the ground. As the shooting continued, the monkeys began running through the high branches, springing from one to another with wonderful agility and dextrously keeping thick limbs and foliage between their bodies and the foe below. Yet before they could get away more were shot down.

Saa's mother, as lithe and cunning as any in the band, had been hunted before. One of the first monkeys to reach the treetops, she had hidden in a mass of leaves and vines growing near the summit of one of the biggest trees. And there, despite the clamor and the shooting, she had stayed trembling with her baby.

A dull thud a short distance away marked the fall of a mandrill shot with a poisoned dart. It had died about two minutes after being hit. The dart had been cunningly prepared, partly cut through just behind its poisoned tip, so that if a wounded monkey tried to pull it out it broke off, leaving the venomous point inside the puncture.

Farewell to the fallen

Saa still clung tightly to his mother's hair. Motionless the two watched the bush-men below. They saw their dead comrades, strangely limp, collected and flung in a heap on the leafy ground. They watched hands and feet being tied together, and poles passed between the lashed limbs, so that the dead animals hung from the poles.

The black men, laughing and chattering, ate some food which they had carried rolled in leaf wrappers. Then they shouldered the pole-loads of dangling monkeys and carried them away.

For a long while Saa's mother remained silent and motionless in her hiding place—for so long that Saa, forgetting his recent experience, fell asleep. At last she stirred cautiously but almost instantly "froze," as her keen eyes caught a movement in a tree not far away. It proved, however, to be a young mandrill who had also hidden himself safely. Presently several others of the group showed themselves. The leg of one was bleeding from a small bullet wound.

In anxious refuge

Uncertain and leaderless, the survivors of the massacre wandered in the forest. One or two young mandrills scouted for fruits, nuts and insects. With the approach of darkness the youngsters climbed with their elders into the branches. Each monkey chose a crotch well above the ground where, fair or rainy, he passed the night hours. But the animals remained uneasy. They missed the vigilant old leader who customarily placed himself on guard beneath them at the base of a tree, or sometimes climbed a few yards above ground.

Dawn spread over the land. Light picked out the tops of the trees while night yet reigned below. Presently mandrill after mandrill slipped down among the drenched undergrowth and began to search for breakfast. In October two favored foods were common: large, round nuts locally named "iron-nuts," pulpy and pleasantly scented inside, and giant beans whose twin cotyledons split apart soon after the beans fell from their foot-long pods. The mandrills were accustomed to feed freely on that fare. Often they carried additional supplies in their capacious cheek pouches. To amplify their fare they scratched up the ground or tore apart rotting logs in search of fat, white beetle grubs.

Though forgetful of their fright the band remained uneasy. They tended to keep moving. From time to time one or another individual tried unsuccessfully to assume leadership in the absence of the old chief. Though the troop as a whole lacked cohesion, most seemed to have forgotten the cause of it all. Conversations started: confidential "qua-qua-qua," and angry "ca-ca-ca-ca-ca," as one chased another who had snatched a morsel of food. But mainly the silence was broken only by the faint sound of pulpy nuts being munched or the fall of a rotten stick dislodged by a shaken vine.

Saa's mother breakfasted with the other mandrills. She cared for Saa, who as yet had scarcely set foot on earth. The sunlight began to filter through the trees. Shining patches of leaves near the ground attracted brilliant butterflies, which flitted and wheeled about them. In the north, clouds already gathered in readiness to pour the noon-hour showers over the forest.

Suddenly, very faintly came a sound! The mandrill troop became motionless, tense. "Oomp-oomp-oomp," the old chief was calling to his lost flock. One after another the old ones, especially the females, began to move. The younger animals followed. The band's trend of travel showed direction once more.

They did not meet the leader at once. Sometimes he failed to call for an hour, and the band, forgetting its objective, stopped to feed. Bursts of heavy rain dashed over the forest, during which most of the monkeys huddled into semi-shelters. They paid no attention to light showers.

[illegible] All was matter of fact. One minute they were alone, the next he materialized, [illegible] Dane.

* * *

Saa grew into a small-boy mandrill. The flutings [illegible] leafier. A tinge of yellow [illegible] around his neck suggested where the band [illegible] would appear. As yet no trace of the blue and red, such as marked the visage of the [illegible] appeared on Saa. He was still a small gray-brown monkey with a very short tail and hard, horny [illegible] where he sat down. But now he could forage for himself. He [illegible] among the branches with the grace of a cat. And he played endlessly with the other mandrill children.

Months passed. After the shooting episode, the "Old Man" had led his charges deep into the forest to the north. No other hunters had been seen. The band had moved far out of earshot of the rumbling trucks that daily traversed the dirt road between Kribi and Lolodorf.

A new home

One day they came to a patch of forest where small trees and branches had been torn and smashed. The ground appeared trampled by huge, flat feet. The old mandrill quietly withdrew. "Mandrills fear elephants," say the bush-men.

There Saa grew up. His once short face lengthened and took on the dog-like form of the adult male. Four huge canine teeth replaced the little ones of childhood. Great bony ridges swelled each side of his muzzle. The fluted areas of skin, covering the ridges, became clear, pale blue. His nose grew yellowish, shot through with streaks of crimson; and along its top, from between his eyes to its tip, a red-purple line developed.

His hindquarters turned as blue as his face, and patches of red appeared; there the hair thinned, letting the colors show through. Around his neck a mass of tawny yellow hairs formed a fine ruff, which joined a crest of hairs on the crown of his head, a crest that stood erect when he grew angry.

He became angry rather easily now, especially with the other young males of his own age. But the old leader kept him and the others in their places, sometimes even driving the more aggressive animals away from the tribe. Such secessions were costly because the retiring male often enticed several females to accompany him.

Next to the leader, Saa became the largest, strongest mandrill in the group. Some months later the inevitable fight for dominance occurred. Saa felt fit and sure of himself. Perhaps it was due to the obvious admiration lavished upon him by several young lady mandrills, his erstwhile playfellows; but mainly it was because he had come of age, reached his full strength and stature, and sensed that every nerve and muscle was in fighting trim. The young ladies cavorted around near him, obviously flirtatious. Saa, forgetting the chief, pranced proudly and self-consciously before them.

Saa meets his rival

A sound between a snarl and a roar brought him back to reality, as the jealous "Old Man" rushed at him, fangs bared. For an instant the habit of years controlled Saa. He half turned to scuttle away in the bush or scramble for safety up a tree. The next moment something, perhaps the splash of adrenalin in his bloodstream, induced by the cloudy ideas of matrimony drifting through his simian brain only seconds earlier, overcame his instinct to retreat. At any rate he stood his ground, tense, every hair of his great mane erect, and snarled back into the face of the leader.

The two great animals locked in a roaring, screaming heap. The great canine teeth slashed and stabbed, as each strove for a telling hold. The rest of the band took instantly to the trees, whence they commented excitedly upon the fight.

Finally the "Old Man" broke away from his opponent, and bleeding from a score of cuts ran into the forest. Saa made no effort to pursue him. He strutted about the spot where the fight had taken place. Then he began looking for food. The mandrills watching from the treetops joined him.

In his new capacity he nightly crouched near the ground, guarding the troop against the dangers of darkness, while they slept among the branches above him. In the daytime he played wary sentry while his people hunted for food.

Once nearly a year later they met the old leader. His blues had become bluer. The red of his muzzle blazed crimson. His disposition seemed more surly and irritable than ever. Nevertheless, he made advance, which Saa firmly repelled.

Saa's troop of mandrills grew in number to nearly 40 strong and ranged through an area of forest some 20 miles square. Saa ruled the band firmly, as his predecessor had before him. Thus once more the pulse of new blood was beating in the life-pattern of the mandrills.

GEM FOR FEBRUARY

Legend imparts to the wearer of the sparkling amethyst a power so subtle that even a Bacchus may be a sage

By FREDERICK H. POUGH

Assistant Curator, Geology and Mineralogy
The American Museum of Natural History

IN a latitude where February brings snow and cold the amethyst is particularly appropriate as a birthstone. If it had not lost its power, what a boon the wearing of this stone might be today to the insurance of a stimulated warmth and comfort through this cheerless month. For many are the legends which attribute to this rich purple gem great efficacy in warding off intoxication, no matter what the consumption!

There can be but little question that the Bacchic attribution of this gem is based upon the similarity of its color to that of wine. Amethyst is only one of many quartz gems, but it is surely the most beautiful of all. Quartz is a very common mineral, composed of silicon and oxygen and nothing more. But pure quartz is rare in nature, and when it is so found it is often used as a gem under the name rock crystal. More often a minor impurity colors the quartz, usually making it less pleasing. Not so, however, when the impurity gives an attractive coloration, as it does to the amethyst. But even today we do not know the exact cause of the color of amethyst: some think it due to a trace of manganese, though none has been found in the most sensitive tests; while others suggest that it is iron, or even some complex optical result of multiple twinnings within the crystal.

Like all the birthstones, amethyst is one of the best known jewels, but this does not detract in any way from its charm of color and beauty as a gem. In modern times Russia has produced some of the finest stones, and though none come from there today, the Muscovite influence is still felt, for any finely colored stone, no matter what its source, is called a Uralian amethyst, after the Ural Mountains. It is said that this region of almost unparalleled mineral wealth was the standard answer of the Russian schoolboy to almost any geographical question. Upon being asked where anything was found, he had only to answer, "In the Ural Mountains," to be assured of a fair chance of being right. The deep wine-red of the finest quality amethyst is still known, but the Urals no longer supply the world. Brazil and Uruguay have supplanted Russia in that field.

The Brazilian deposits consist of two types: the less important is in a white sandstone that yields large but pale crystals encrusting the walls of caves and fissures; more important are the hollow boulders, weathered from basaltic rock and lined with layer after layer of banded agate, or with amethyst crystal crusts. The latter type is found near the Uruguayan border. Tremendous slabs of these crystals have been collected, varying in color from very pale purple to deep shades as fine as those from Russia. Carbon dioxide gas is often included in these crystals, and many specimens in collections show small pits where the reduced pressure of the surface has permitted the confined gas to escape by exploding outwards.

Coloration in an amethyst is almost always irregular. Most genuine amethysts, when viewed through the back, can be identified by an irregular distribution of areas of colorless or pale purple quartz and areas of deeply colored amethyst. Imitation amethysts are uniformly colored. Although amethyst has been found in the United States and many stones have been cut, some of high quality, the American supplies are neither large nor consistent enough to provide much of the world demand and are consequently of little economic importance. Maine, New Hampshire, Virginia, Georgia, Montana, and many other states have all produced some gems, and there is hardly a state in the Union where collectors have not found purplish quartz which could be considered amethyst.

A.M.N.H. photos by Bierwert

An amethyst crystal from Georgia

A carved amethyst snuff bottle from China

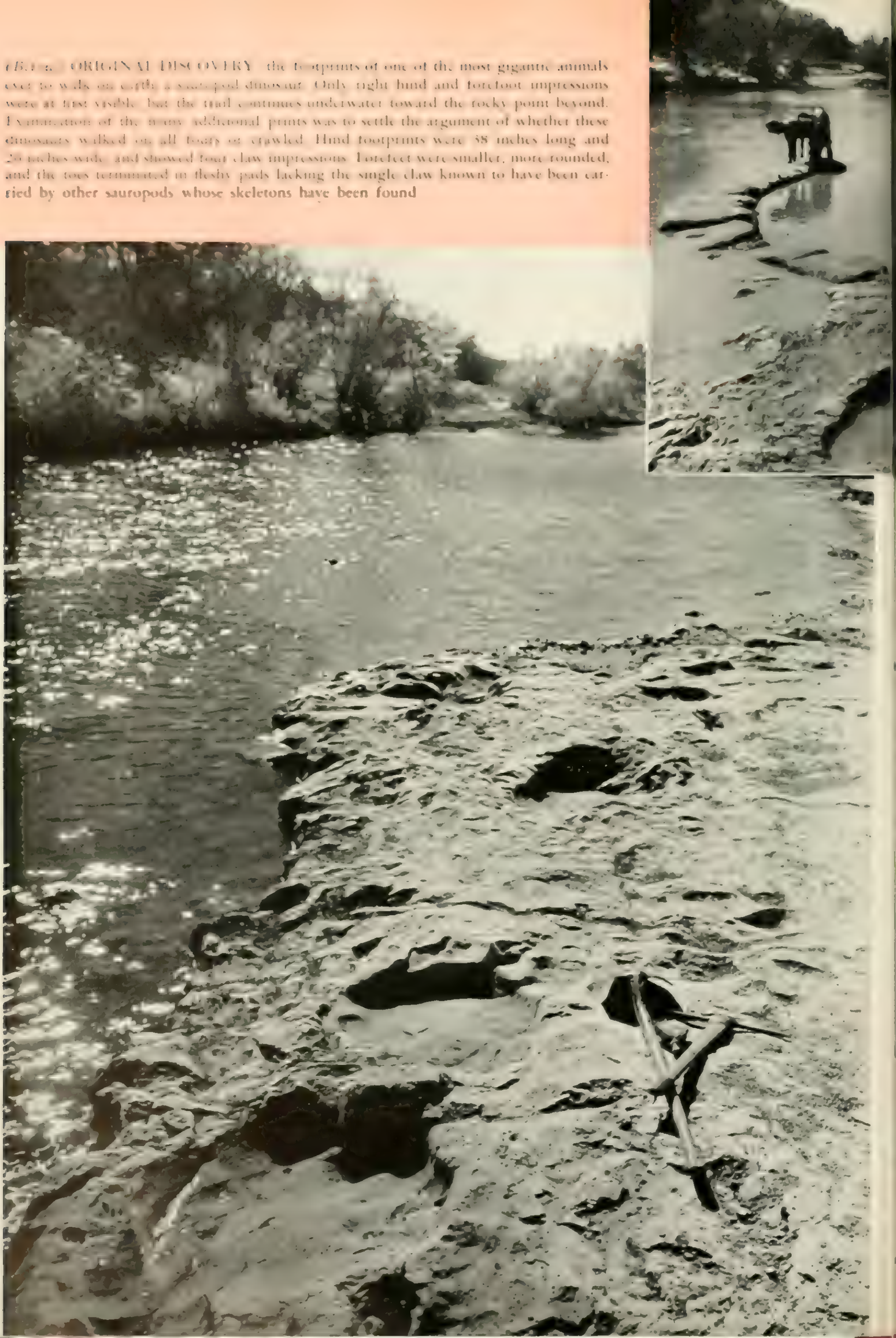
An old French verse tells of the origin of amethyst: Bacchus was vexed with Diana and vowed to set his beasts upon the first person he met in the forest. This chanced to be Amethyst, a beautiful maiden. When she appealed to Diana for aid, she was turned into marble and spared from what is supposed to be a worse fate. Bacchus in contrition overturned his wine glass on the petrified maiden, dyeing the marble the color of the juice.

The oldest attributes of amethyst all deal with its efficacy in warding off intoxication. In common with other gems it was supposed to guard against illness and control evil thoughts. Others thought it would quicken the intelligence and make men shrewd in business, keep soldiers from harm and help them to conquer their enemies.

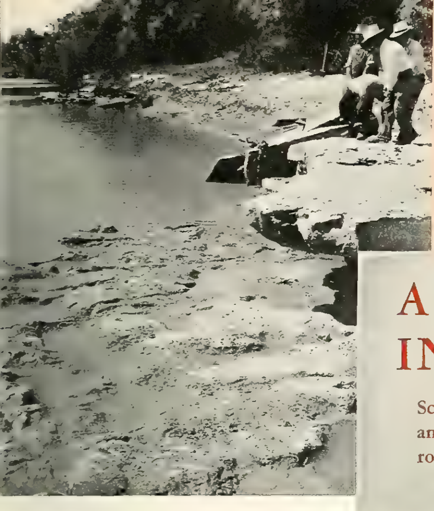
Even in the Christian religion the amethyst was regarded with respect. St. Valentine, whose day falls within this month, is supposed to have worn an amethyst ring with a figure of Cupid engraved upon it.* The name amethyst is derived from a Greek word meaning "not drunken." Another name, Bishop's Stone, comes from its customary use in the episcopal ring. Evidently the amethyst's special efficacy was not overlooked by bishops, who must remain sober, but whose duties, as L. J. Spencer puts it, take them to all sorts of public functions. G. F. Kunz suggests the interesting thought that the Hindus included almandine garnets under the name amethyst, and may have carved from them cups in which the wine color would not show, so that one could drink pure water from them and give the impression of extensive drinking yet remain sober.

Amethysts were much more highly valued formerly than they are today. A necklace once valued at $10,000 is said to be worth hardly $500 today. Even though the supply is now more abundant than formerly, the demand is excellent. Despite the modern disillusionment of the amethyst's power over alcohol, its lovely color has insured a constant demand. The continued production of high quality material has kept the price of amethysts within the means of all who like to wear jewels, whether they were born in February or not.

**It is doubtful whether either of the saints known as Valentine was a patron of romance. See "The Massacre of St. Valentine's Day" on page 100 of this issue*



(Below) ORIGINAL DISCOVERY: the footprints of one of the most gigantic animals ever to walk on earth, a sauropod dinosaur. Only right hind and forefoot impressions were at first visible, but the trail continues underwater toward the rocky point beyond. Examination of the many additional prints was to settle the argument of whether these dinosaurs walked on all fours or crawled. Hind footprints were 38 inches long and 26 inches wide, and showed four claw impressions. Forefeet were smaller, more rounded, and the toes terminated in fleshy pads lacking the single claw known to have been carried by other sauropods whose skeletons have been found



(Left) FIRST MOVE in following the trail was to construct a cofferdam of sandbags so that the area could be drained and the tracks examined. Originally made on a soft mud flat, the trail was later covered by silt laid down in comparatively quiet water. On top of this, inland seas which invaded parts of Texas approximately 100 million years ago deposited sediments. These ancient, consolidated deposits have long since been elevated high above sea level, and the tracks have been exposed by the cutting action of the Paluxy River, which flows across them today

A DINOSAUR WALKS INTO THE MUSEUM

Scientific detective work sheds new light on the habits and appearance of the most gigantic animals that ever roamed the earth when the biggest footprints ever found are placed on display

By ROLAND T. BIRD

Department of Paleontology, The American Museum of Natural History

WITH PHOTOGRAPHS BY THE AUTHOR

PIECING together the story of prehistoric animal life is, in its entirety, a gigantic scientific detective problem. Rarely, however, does the process suggest so closely the classic methods of Sherlock Holmes as in the case of the footprints of the "Thunder Lizard," for important new information on the appearance and mode of life of this titanic dinosaur has been deduced from the trail which he left in mud some 120 million years ago.

The general appearance of the "Thunder Lizard" has been known from abundant skeletal remains, fossilized in the rock pages of the earth's history. But whether he walked on his four feet and trod the dry earth or lumbered about in shallow water, remained unknown, along with other important facts, until the eye of science fell upon these tracks.

Of all creatures that ever walked on earth, the "Thunder Lizard," Brontosaurus, and other dinosaurs of his group, the sauropods, hold the world's record for size. Indeed, they seem to have reached the possible limit that an animal with feet could attain. A few other sauropods were larger, but Brontosaurus is typical of the group.

One day late in November, 1938, while prospecting 80 miles southwest of Ft. Worth, Texas, I noted three or four huge depressions in the bed of the Paluxy River,—footprints of these gigantic monsters. On a rock ledge leading underwater was undoubtedly a trail left by a 60- or 70-foot sauropod weighing 20 or 30 tons, probably the "Thunder Lizard" himself. Specimens of this sort were hitherto unrecorded, and I faced the problem of removing a suitable selection for the American Museum.

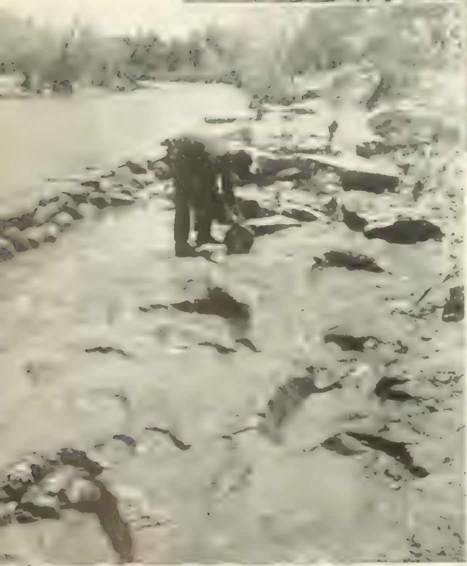
The task promised to be in keeping with the magnitude of the tracks involved. How would one cope with the whims of a temperamental river while tracing 38-inch footprints underwater? By what method could a suitable section be removed from the solid rock? At each stride the animal moved ten or twelve feet. Where, indeed, could such a large exhibit find room in the Museum's halls?

Almost two years later to a day, after five months of intensive work, the largest single display of dinosaur tracks ever uncovered was boxed up. With so great a wealth of material available, two other institutions shared in the collection. In all, 40 tons of track-bearing rock were removed from the river bed.

Visitors to the new Jurassic Hall in the American Museum will in time see the original footprints mounted in the base of the gigantic skeleton of the "Thunder Lizard." As if this 120-million-year-old monster had just strolled into his present position in the hall, you will see the tracks as he would have left them, six front and six hind footprints, under glass resembling the water in which he waded. This solution of the exhibition problem had already occurred to curator-chief Barnum Brown's fertile imagination before the venture was assured.

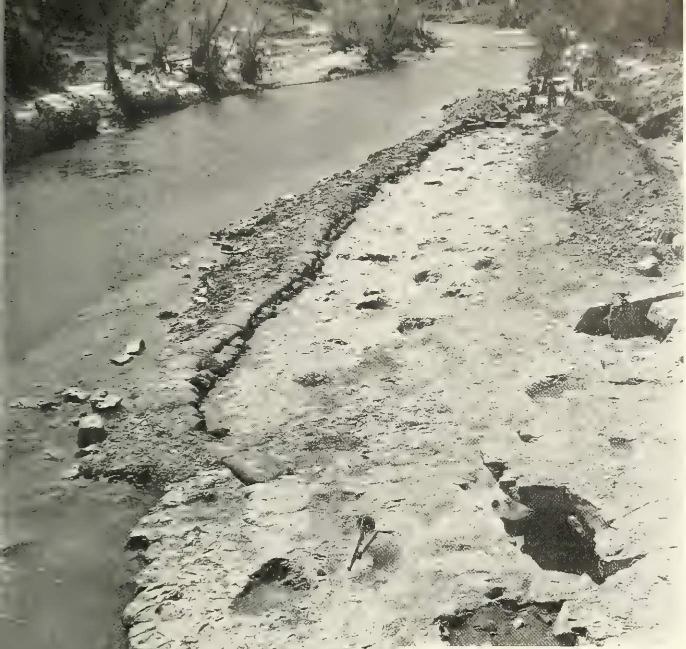
What the tracks revealed and how they were removed with the aid of the Texas State-Wide Paleontological Survey, a Works Progress Administration Project, is told in these pages. To Dr. E. H. Sellards of the Bureau of Economic Geology of Texas goes credit for having made possible this valued assistance. To all my other Texas friends, far too numerous to mention singly, who helped in this quest, both at Glen Rose and Bandera, where one other known locality for this type of track was found by us, I extend my heartfelt thanks.

(Left) THE DAM rapidly nears completion as men drag sandbags across the mud-filled potholes that mark the course once followed by the dinosaurs. Fossil hunting, entirely a new experience to the crew, all local men, excited mild curiosity in some, in others, keen interest. When told that the name Brontosaurus means "thunder lizard," Monroe Eaton declared, "One certainly went here that shook the ground"



(Above) TRACKS begin to appear as water is drained from the area. Lacking a gasoline pump, the men used buckets to remove the water, and could bail about twelve barrels a minute by this method. Keen to see what the tracks were like, they completed the task in less than two hours. But recurrent floods were to refill the dam many times

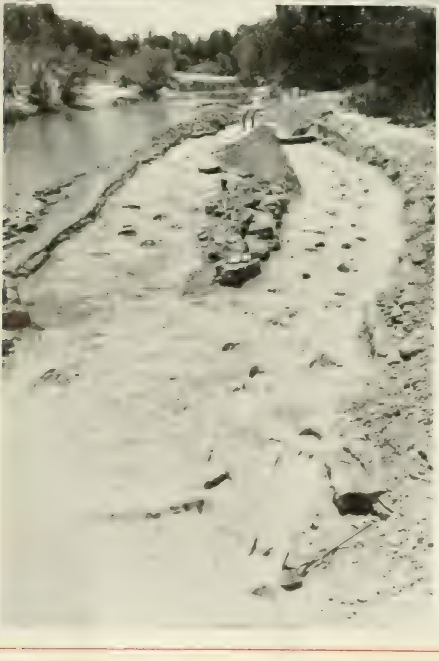
(Left) THE BIG TRAIL led toward a shelving ledge and disappeared beneath it. One local man, inclined to scoff at the notion of finding additional tracks beneath the undisturbed overburden beyond, laughingly said, "Why, that animal didn't walk under all that rock!" Actually, of course, the dinosaur walked before the overlying rock was deposited as soft sediment. From a study of the rocks the scientist can reconstruct the landscape and climate at the time



(Left) A VIEW looking upstream along the tracks which had been underwater discloses positive proof that this great animal walked on all fours, for the hind and front footprints are clearly discernible in regular order. Only in one trail, at Bandera, were there eight or nine forefoot impressions and only one hind one, where a sauropod, buoyed up enough to go on fore legs, had put down a hind foot to turn. The absence of any mark of a dragging tail except in one instance was the next clue to the dinosaur's habits. Fully 25 feet long and very heavy, the tail could not have been carried in the air. Therefore, the animal must have waded in the water, where the tail, tending to float, could have been held off the bottom

(Below) AN EXCAVATION revealed much more of the path of the dinosaur, which swung gradually to the right. Was the dinosaur alone when he waded across the mud flat 120 million years ago?

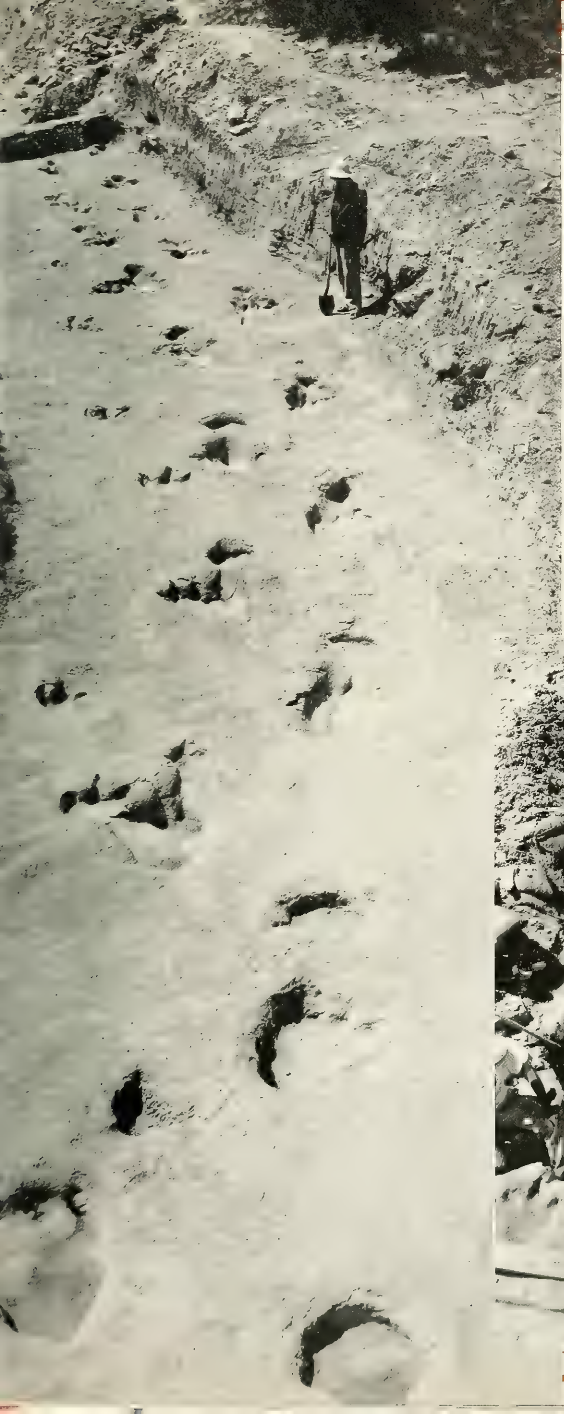
(Left) ANOTHER TRAIL is found. While widening the excavation, a new series of even more promising tracks was located, coming in from the north on the bank side. Again beckoned by the unknown, the diggers began a new excavation to trace this second trail. Further surprises were in store



(Above) A JUTTING LIMESTONE LEDGE is in the way, so it must go: broken sections being moved away with the aid of bars and rollers. It contained many fossil oyster shells and other marine invertebrates left there when the sea advanced over the area.

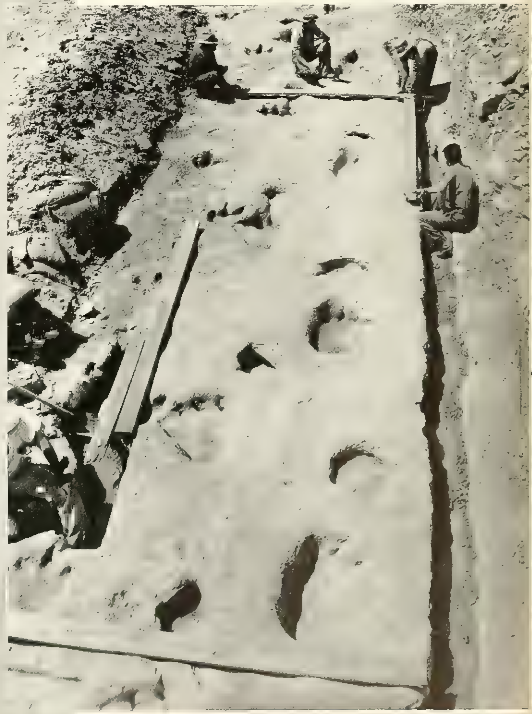
Why have no sauropod tracks been discovered farther north in the United States, where skeletons of the animals have been found in large numbers? Dr. Brown deduces that only in seaside mud flats, as distinct from lake marshes, would the putty-like earth of decomposed marine organisms be firm enough to receive and hold the impression of the feet while underwater. Preliminary examination of the rock bears out the conclusion that the dinosaurs here were wading in a shallow, brackish arm of the sea, though the spot is now almost 300 miles from the coast. Farther north, where sauropods frequented the lakes, they died in great numbers in diminishing pools when the drying up robbed them of the water necessary to their existence

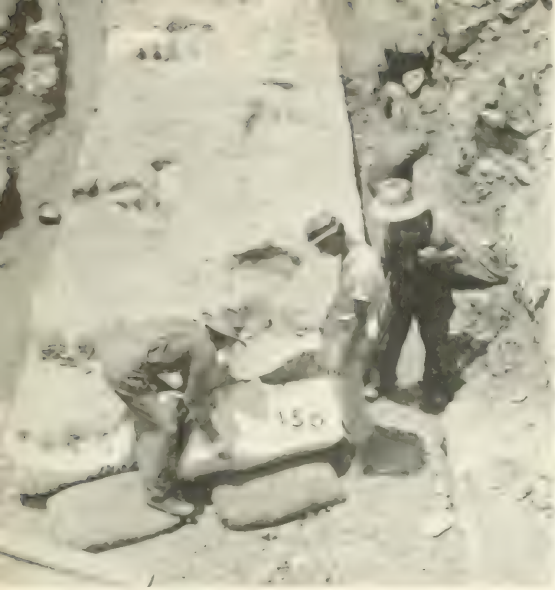
(Left) WITH the limestone ledge blasted and cleared away, Trail Two stands out clearly on the right. Other trail disclosures indicate that no less than a dozen sauropods had crossed this section. All were progressing in the same direction as a herd moving across a shallow mud flat



MOST INTERESTING FEATURE uncovered during the season's work was the trail of a flesh-eating dinosaur following that of a sauropod. This is seen at the left of Trail Two as a row of three-toed footprints. Made at a time when the mud was of the same consistency, these prints suggest that a fourteen-foot flesh-eater was actually stalking the big quadruped. At any rate, when the sauropod swung to the left, the carnivorous dinosaur did likewise. Along this ancient waterfront, the territory of these two distinctively different types of dinosaurs overlapped

(Below) PREPARATIONS are made to remove the first slab of tracks, 29 feet long by eight feet wide, to be placed under the tail in the base of the Brontosaurus skeleton in the American Museum. Most fortunate circumstance of the entire season was the comparative thinness of the track-bearing layer, which was less than eighteen inches thick. The rock rested on a four-foot bed of soft clay and was not difficult to cut with chisels. The sequence and association of fore and hind foot impressions are typical of the trail made by any slow-moving, very heavy four-footed animal. Later a suitable section of the flesh-eating dinosaur trail was taken





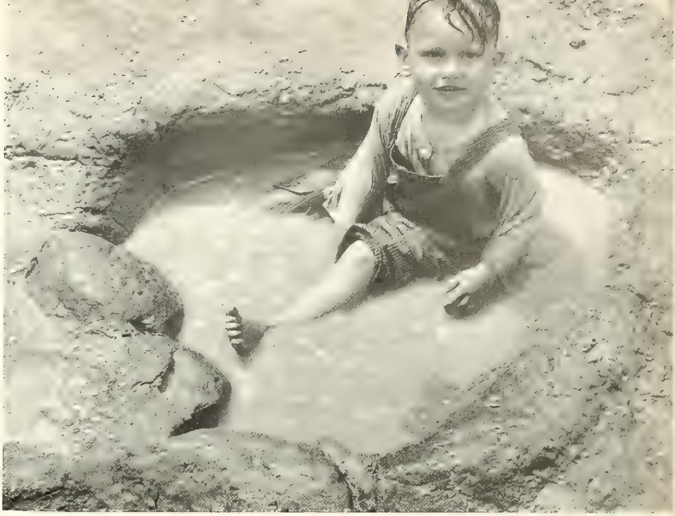
HOW REMOVAL of this 30,000-pound track slab was possible. In addition to the fortunate bed of clay underneath, the block also had convenient cross-fractures which allowed easy blocking off into sections. The edges were then covered with plaster jackets to preserve clean contacts, sections were given numbers, and their relationship recorded on a chart, so that re-assembly would present no problem

PHOTOGRAPH OF THE PHOTOGRAPHER: the high scaffold "tripod" from which most of the trail pictures were made. In the background below, men are reducing the weight of several sections of slab by chiseling off surplus stone from the underside, preparatory to moving them up a 30-foot river bank where they were to be picked up by truck

AFTER the American Museum specimens were removed, other track slabs were taken for the University of Texas and the U. S. National Museum in Washington. This photograph at right is not a picture of the world's biggest jigsaw puzzle but just a fraction of the 1200-piece, 40-ton collection of tracks being crated for shipment. Materials used on the job included 1500 burlap sacks, 2000 pounds of plaster of Paris, and 8000 Kleenex tissues (to prevent plaster from adhering to track surfaces)

(Left) ONE of the major vicissitudes associated with collecting fossils from a river bed. When the river rose, dikes broke, and the quarry filled with mud. Most exasperating were repeat performances, just after the quarry had been cleaned. This shows the river receding from a typical five-foot rise, of which there were half a dozen during the summer

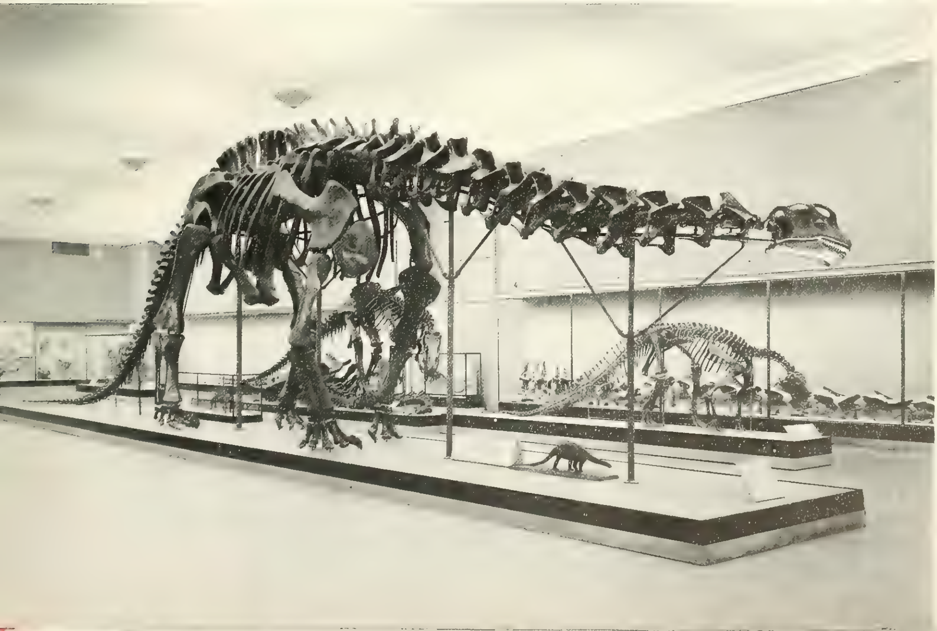
Above is shown the footprint of a large modern elephant reproduced in the same scale for comparison with the dinosaur footprint at right



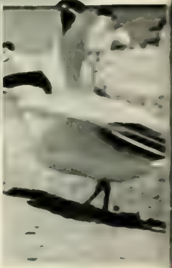
HOW BIG is a big sauropod track? The young man examining this one, even to the point of taking a bath in the crazy thing, is young Tommy Pendley, who just wanted to find out. The footprint held eighteen gallons of water. Hailing from Cleburne, Texas, Tommy was the three-year-old son of one of the men engaged on the project

(Below) THE SKELETON of a sauropod, approximately the one which left his footprints in Texas mud: Brontosaurus, under whose tail the footprints will be mounted in the American Museum's new Jurassic Dinosaur Hall. Once living in fresh and brackish water of lakes and lagoons, these creatures floated their huge bulks around in quest of the plants on which they lived, occasionally wading close to shore. That they were sometimes preyed upon by the fierce flesh-eating dinosaurs of the times is known from tooth-scarred bones, as well as from the tracks of a flesh-eater apparently following the trail of one of these huge creatures the whole length of the quarry in the foregoing photographs. The skeleton is over 66 feet long and stands 15 feet high at hips

AMNH photo by Coles

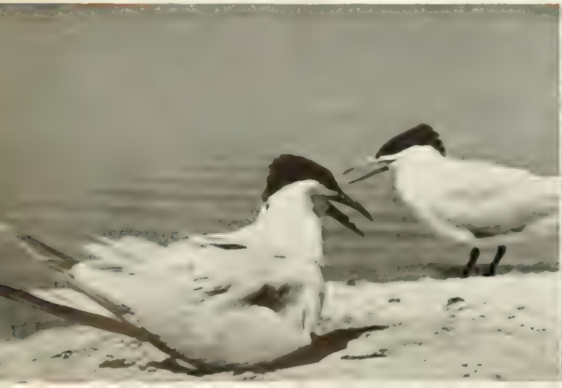


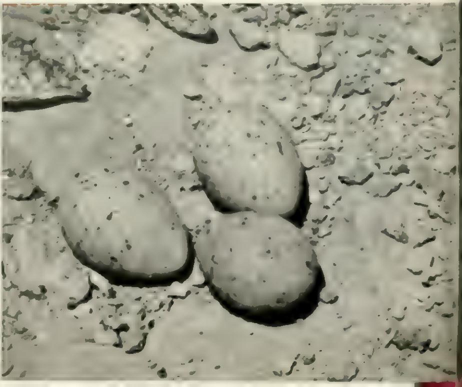
PORTRAIT OF A KING. With wings out-stretched and bill open, this Caspian tern asserts His Birdship's rights in defiance. Almost as big as the common herring gull, the heavily-built Caspian is the largest of all terns. Although its tail is forked, as are those of most terns, the fork is not conspicuous, thus heightening the bird's resemblance to a gull



1 Caspians differ from royal terns in the way the Caspian's wing tips extend beyond the tail when at rest

2 Two or three light buffy eggs spotted with brown and gray make up the normal clutch of the Caspian tern





THE CASPIAN TERN

Sand, sun, and marauding man are a family problem for one of the world's most widely distributed birds

By RICHARD H. POUGH

With illustrations by
MELVIN T. JOHANSEN

KING of all the terns is the nearly cosmopolitan Caspian [*Hydroprogne càspia* (Pallas)]. Ever since the first specimen was recorded in 1770 near the Caspian Sea, this graceful, gull-like creature has gained recognition on every continent save one, South America. Adaptability to both salt and fresh water doubtless helps to determine its wide range. In the Western Hemisphere its breeding colonies are scattered all the way from such northern areas as Great Slave Lake, the coast of Labrador, and the Great Lakes, to the Gulf Coast of Texas; and in the Eastern Hemisphere, south to Cape Province in South Africa and New Zealand. Few birds have so great a range.

Though widely distributed, the Caspian is not an abundant tern. Hundreds of miles often separate its breeding colonies. A colony may consist of only a few pairs of Caspians who scorn the companionship of lesser species, or it may have 1000 individuals, as in the case of the California ternery shown in the accompanying photographs.

The Caspian's shyness has defied the plumage hunter but has proved no protection to the eggs, an enticing titbit for the marauder but a serious loss to the Caspians, since in certain regions their numbers have been materially reduced. The spotty distribution seems to indicate survival of a more abundant species.

Its effortless, graceful flight carries the bird to northern breeding colonies in eastern and western Canada, and thus the Caspian is at least an occasional migrant on almost every large body of water in the country and along the seacoast. On the South Atlantic and Gulf Coasts, it is considered a permanent resident.

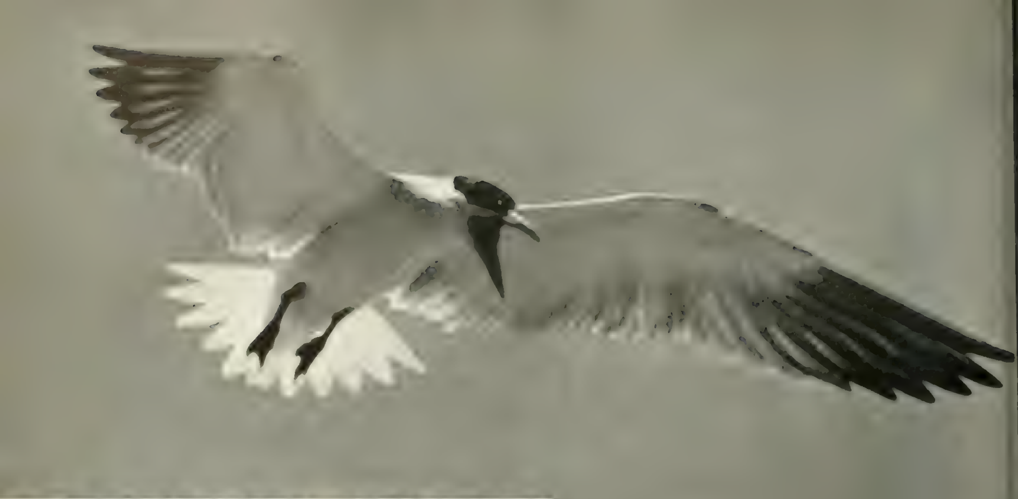
Among the vast hordes of colonizing terns none is larger, stronger, or fiercer than the Caspian. Though resembling the royal tern (in fact, they were confused by so great a naturalist as Audubon), the Caspian's aggressive "individuality" has indeed won him imperial honors in birddom.

Only one group of Caspian terns, inhabiting Australia and New Zealand, is at present recognized as possibly constituting a separate subspecies.

CASPIAN TERN colonies are often associated with those of other sea birds. The nests, closely spaced, form a compact group usually somewhat separated from the main colony

3 Storms and high tides frequently destroy the eggs before the 20-day incubation period is completed

4 Ants can be a serious threat to hatching terns, devouring them before they get out of the shell



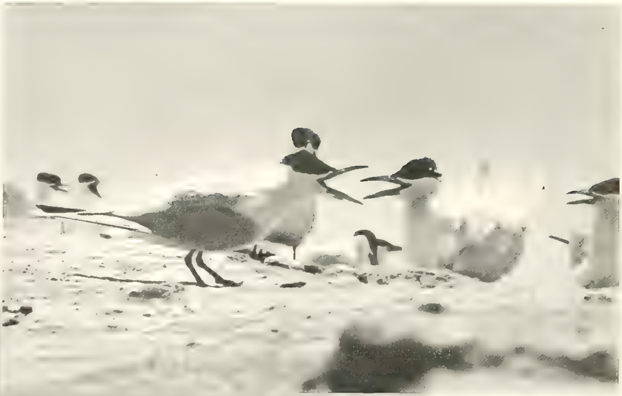
(Above) THE heavy carmine bill is one of the Caspian's most conspicuous field marks. The large amount of dark on the primaries, especially as seen from below, also helps to identify it

5 *(Left)* After the exhausting struggles to free itself from the egg, the young tern lies motionless while its down dries. A strong wind, by blowing sand which sticks to the wet down, sometimes buries a young bird alive at this stage

6 A few hours after hatching, a young tern is a fluffy ball of grayish-white down, spotted with black. Although active, they must beg for their food

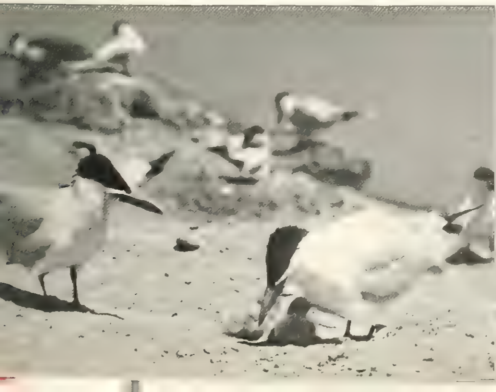
7 The summer sun's rays can quickly kill young terns Thoughtless onlookers sometimes destroy hundreds of young by preventing the parents from sheltering them

(Right) CLOSE CROWDING of the nests produces numerous territorial clashes between adjoining pairs

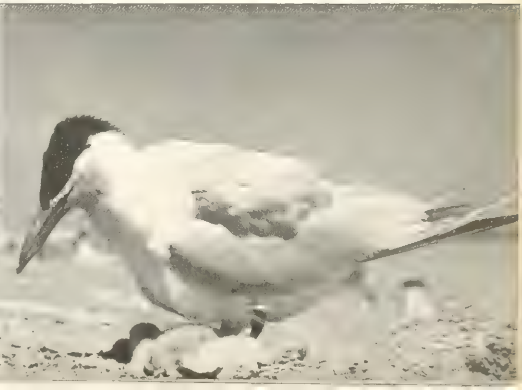


(Left) A TERN COLONY is a continuous bedlam of noise whenever a human is in sight. The note of the Caspian is a very characteristic deep, raucous "ka-arr." Once learned, it enables one instantly to separate the Caspian from other terns

8 Raw rather than predigested fish appear to make up the sole diet of the young. Three- or four-inch fish are swallowed part way and then digested by degrees



9 Terns seem always to know their own offspring, and the young their parents, whose calls they appear to recognize. Toward other young the adults are most brutal

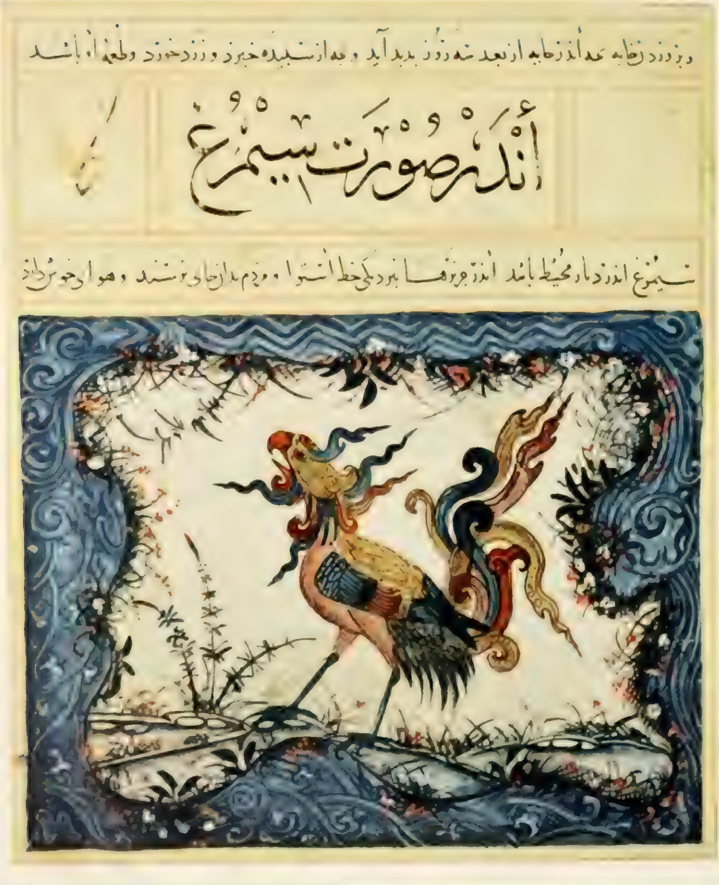


HOW DOST THOU PORTRAY THE SIMURGH?

[illegible]

[illegible]

BEHOLD THE SIMURGH! Although it recalls [illegible] as every fire-[illegible] by the imaginative powers of a Persian manuscript illustrator of the thirteenth century. But later a fellow countryman indignantly penned in the margin of this bestiary, "Thou fool! If nobody has seen the simurgh, then how dost thou portray it?"



Introducing the Story of Animal Art through the Ages

Although it covers much material not represented in that collection, this article is written with special reference to the Pierpont Morgan Library and to its exhibition, "The Animal Kingdom," open until February 28, 1941. Indebtedness to the excellent catalogue by Helen M. Franc and to the thoughtful arrangement and enlightening labels of the exhibition is gratefully acknowledged.

WHAT would you say is the most exclusively human accomplishment and the most indispensable basis of civilization? Ask this question of a group of people and you will receive many answers: foresight—the ability to use tools—speech. These are certainly indispensable and they certainly reach their highest development among humans, but they are not exclusively human and they are not peculiarly associated with progress toward civilization. Ants show foresight. Apes use tools. Birds have a rudimentary sort of speech. The ancestors of the most primitive modern races had all these characteristics nearly as well developed as we do; but their descendants remained savages while other races developed the highest civilization.

This magazine and the museum that publishes it are excellent examples of what seems to me the best answer to my question: the ability to make records, to store up and to communicate any sort of idea or observation beyond the reach of a single voice or the span of a single life. This ability is, indeed, exclusively human; it is shared by all civilized men, and its acquisition by any race leads inevitably to higher cultural levels. Such records are of many sorts. Writing is now by far the most important, but it is not the only method, nor the most ancient and fundamental. The modern museum's presentation of groups and paintings is the highest type yet evolved of another sort of record. The Okapi Group in our Akeley African Hall, for instance, records with perfect fidelity every detail of the appearance of the okapi and of its natural surroundings. It communicates this record to millions of people who have never seen these things and who have never talked to anyone who has seen them. Photographs and paintings, like those reproduced and circulated by the Museum through NATURAL HISTORY Magazine, achieve the same end in less vivid but more distributable form. Such accomplishments have extremely ancient origins, long before Rome or Babylon, and they are the result of a long and fascinating history.

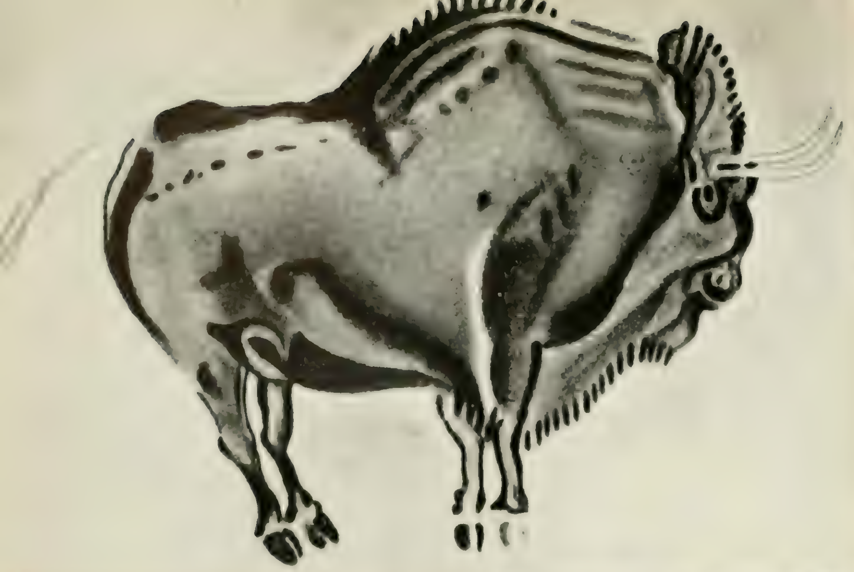
The earliest known human records are pictures of animals. The cave men of ancient France painted on rock walls, scratched on bone, and modeled in clay pictures of their favorite animals: horses, deer, mammoths, bison, and others. These animals were their favorites because they were good to eat. As the cave man recorded his menu on the walls of his cave, he was unconsciously communicating to us his observations on the creatures of his day. In some cases, particularly the mammoth and the woolly rhinoceros, we know through his drawings what an animal now long extinct looked like to an eyewitness.

Such communication of observations is the essence of scientific illustration, and the cave man might be called the first scientific illustrator, except that this was not his intention. He had in surprisingly high degree the other two requirements of scientific illustration: firsthand observation of the object, and technical skill in recording it. The cave man did not make his drawings for the purpose of showing anyone what the animal looked like. He cannot have foreseen nor have been concerned with our appreciation, and his contemporaries had seen the animals for themselves and knew what they looked like as well as he did. Probably he sometimes painted or engraved just for fun and for truly artistic motives of aesthetic expression, but it is believed that the usual purpose was magical.

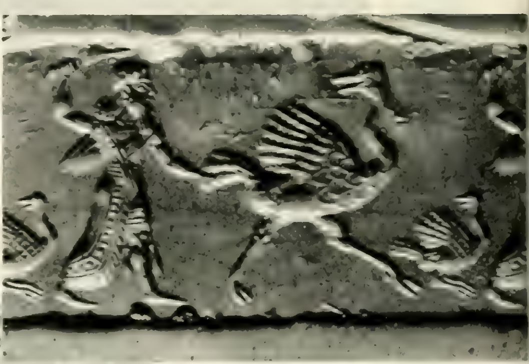
The Old Stone Age representations of animals seem to have been associated with rites or beliefs to promote the increase of game animals and success in hunting them. This would explain why the animals well portrayed are almost always those that were common articles of diet. Representations of animals less often eaten, or of men, are relatively rare and crude in this most ancient art. It would also explain why the cave paintings are commonly hidden away in places where they can hardly have been intended to be seen often and admired by the mob. In a sense these decorated caves were neither natural history museums nor art galleries but churches. The association of animal art with religion, far antedating its association with science, has continued through every age, including our own, and through almost every system of religion, including Christianity.

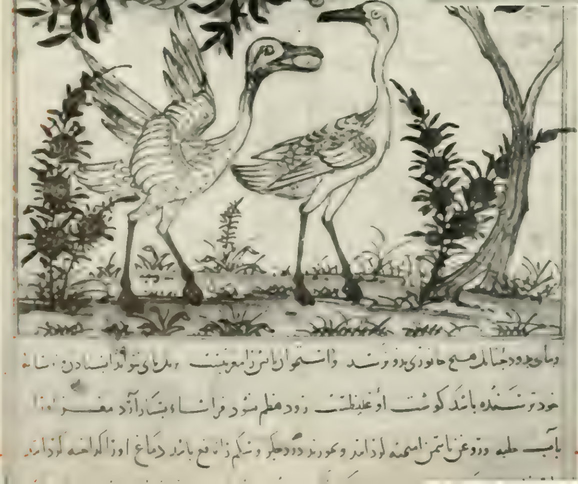
The urge to draw pictures has never abated, and animals, the first subjects, have always been favorite models. It was this urge that led directly to the invention of writing. Drawing a picture of a thing is as good as saying its name. In fact it is better, because the picture can be sent to great distances and can be handed down to posterity. The pictures can be simplified so that they become symbols quickly written. They can be systematized and generalized so that they can express not only concrete objects, but also all sorts of ideas, indeed, all the words or sounds of a language.

Many of the early pictures that later evolved into true writing were pictures of animals, and some of the letters of our alphabet had this origin. According to one theory, disputed but not improbable, *A* was once a picture of an eagle, *B* of a crane, *F* of a horned viper, *L* of a lion, *M* of an owl, and *Z* of a duck. If its letters returned to their original forms, this sentence would resemble a zoo! The animal symbols in the earliest writing, particularly the Egyptian hieroglyphs, were often excellent portraits, but they



UNTOLD CENTURIES before the imaginative artist created the simurgh illustrated on the title page of this article, an anonymous cave man in prehistoric Spain daubed the remarkable likeness of a bison, shown above, upon a rock wall. His portraiture is excellent because it is not imaginary. He had seen the bison many times, and eaten him. His painted caves were probably churches rather than art galleries. The animal pictures served in magical rites calculated to increase the supply of game and bring good luck to the hunters. (Polychrome bison at Altamira, Spain, reproduced from *Cave of Altamira* . . . by Abbé Breuil and Hugo Obermaier)

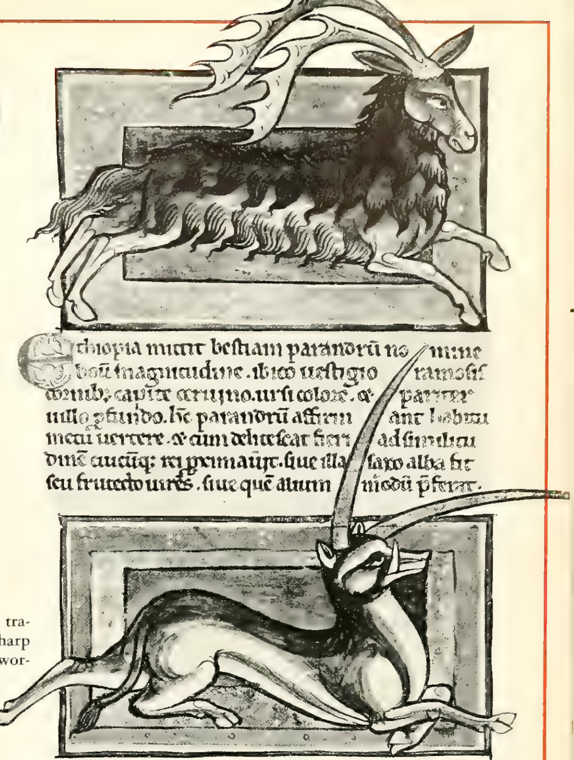




THE ASSYRIAN artist who engraved the hunting scene above on one of the famous Babylonian seals knew his ostriches; the bird is a good, recognizable portrait. But the illustration at left is not. The latter is the work of the Persian creator of the simurgh, who had never seen an ostrich, either. Nothing daunted, he drew a crane with two toes, labeled it "ostrich," and went on his way rejoicing

Courtesy of the Metropolitan Museum of Art

THE ANCIENT EGYPTIANS created a realistic tradition in animal art that was soundly based on sharp observation. Their sculptures of cats, which they worshiped, have never been surpassed. Indeed, they depicted every animal known to them with such skill that the exact species represented can almost invariably be identified



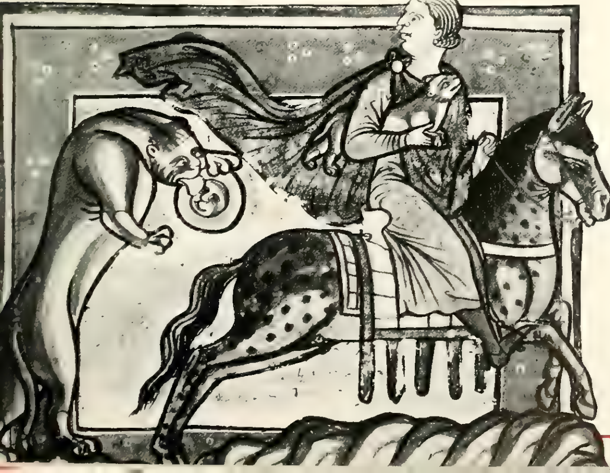
Ethiopia mittit bestiam parandrū nomine
boū magnitudine. bisulco uestigio ramosis
cornib; capite ceruino. ursi colore. & pariter
uillo ꝓfundo. hc̄ parandrū affirmant habitu
metu uertere. & cum delitescat fieri ad similitu
dinē cuicūq; rei ꝓximauit. siue illa saxo alba sit
seu frutecto uirēs. siue quē aliu modū ꝓferat.

Courtesy of the Pierpont Morgan Library

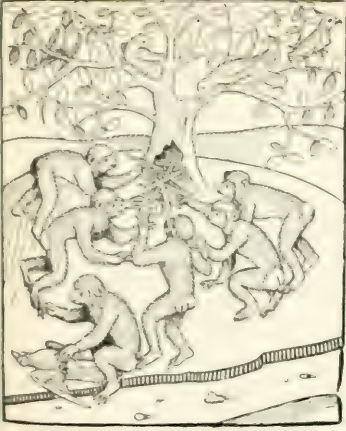
WITH THE COMING of the Medieval Age, animal art declined sharply both in Europe and the Orient. Two great religions turned the eyes of men toward worlds other than the one in which they lived, Christianity and Islam. The latter word means "submission," and this trait in many ways characterized the medieval followers of Christ as well as Mohammed. They believed in authority, not observation. Fidelity to nature was forgotten, and animal artists were interested only in turning out moral symbols

(Above) THE PARANDRUS AND THE YALE. The parandrus is described as "an antlered stag, who like the chameleon can change color according to the environment as the need arises." And the yale, far from the bulldog which the name calls to mind today, was a sort of antelope having swivel-mounted horns that could be pointed in any direction at will. Both animals are from an English bestiary, or "Moralized Natural History," produced in the second half of the twelfth century

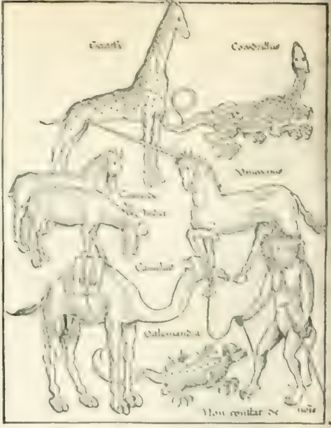
Courtesy of the Pierpont Morgan Library



THE MORAL ADAPTATION of animal lore is clearly shown in the scene at left, depicting a hunter stealing the cub of a tigress. To forestall pursuit he has tossed her a mirror. She is shown licking the image, believing it to be her lost child. The cub is your soul. The hunter, the devil. The mirror represents worldly pleasures. As storytelling, it is excellent; as anatomy, atrocious. Under this moralistic aegis, mythical animals were conjured up on every side



APES AND GLOWWORM. A startling item of natural history appears at left. The original caption for this fifteenth century woodcut is repeated here without comment. "A party of apes, becoming very cold in the high mountains, caught a glowworm and tried to kindle a fire by its light. Their unsuccessful efforts were derided by the birds, which so irritated the apes that they began to strangle the birds." (From the *Directorium Humanae Vitae* printed at Ulm in 1485)



[illegible] illustrations [illegible] the antecedents of [illegible]. They were meant to convey the name of the animal and give a language sound without reference to the animal—but not its appearance. This communication could be made just as well, and much more quickly, without making a careful portrait, and so the pictorial qualities eventually were lost and simpler symbols evolved that retain no hint of their animal origin.

The Egyptians and other ancient peoples of the eastern Mediterranean delighted and excelled in animal portraiture aside from animal-writing. Their art abounds not only in animal gods and mythical creatures, but also in naturalistic studies of real animals that are both artistic and accurate. Probably no one has excelled the Egyptians in portraying cats or the Greeks in portraying horses. Since the Egyptians were particularly fond of drawing animals, it is hard to find any considerable Egyptian painting or relief that does not contain an animal of some kind. With such skill did they make pictures of practically every animal, wild or domestic, known to the ancients, that the exact race or species represented can almost invariably be identified. They even anticipated that great stimulus to animal art in later days, the foreign expedition, for they, too, drew pictures of the men and animals of distant regions to show what they were like.

Except for supernatural beings frankly represented as such—sphinxes, jackal-headed gods, and the like—Egyptian representations of animals are obviously drawn from life with faithful attention to detail. They represent a high point in the history of animal art, a scientific tradition that was later lost, not to be recovered until almost our own days.

A distinction can be drawn between animal art like that of the Egyptians, who depicted animals accurately from models, and the work of artists whose animals were often figments of the imagination, even when presented as sober truth. Two examples in the Morgan Library's current exhibition, "The Animal Kingdom," illustrate the distinction excellently. A late Assyrian seal of the eighth century B.C. shows an ostrich, stylized in keeping with its purpose but anatomically correct and immediately recognizable. The artist certainly knew exactly what an ostrich looks like and how to draw it. In contrast with this, the Persian illustrator of a thirteenth century A.D. bestiary evidently knew nothing of the ostrich except that it was a bird with long legs and neck and two toes. Nothing daunted by the fact that he had never seen an ostrich, he drew a crane with two toes, labeled it "ostrich," and went on his way rejoicing. The same artist revealed the same defect when he came to the hippopotamus, an animal excellently portrayed by the Egyptians many centuries earlier. He knew the name, which means "river horse," and apparently also had the information that it differs from the true horse in having a shorter tail and more than one hoof on each foot. His picture of the hippopotamus shows an ordinary horse, Dobbin with a Persian accent, with a short tail and cloven hoofs like a cow's standing in a river!

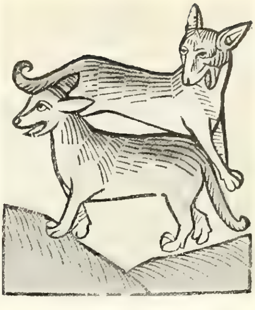
This Persian book nevertheless is representative of the best scientific animal illustration of its day. It was painted in Maragha sometime around 1295. The text, translated from the Arabic for Ghazan Khan, consists of descriptions of the animals and their habits, in large part ultimately derived from Aristotle, followed by what were believed to be their uses, especially in medicine. We would call such a work a treatise on economic zoology, but in the Middle Ages it was called a bestiary.

The medical recipes of this book range from the sublime to the ridiculous. Recommendation of a bit of dragon skin to kill moth eggs runs the whole gamut in itself and is passed on for the benefit of harassed housewives. At the other extreme, the statement that burned oyster shell rubbed on the teeth will whiten them is both true and practical. Carrying a hyena's tooth to improve the memory is practical if not true.

The descriptions of the animals are hardly more realistic than the prescriptions. The bone in the lion's neck is said to be one solid piece so that the creature cannot turn its head. The giraffe is said to have no joints in its front legs. The bear is said to grow so fat from not eating all winter that it can hardly get out of its cave in the spring. The ox is said to cast its horns once a year like a stag. Many of these bits of zoological misinformation pose logical questions suitable for a game of "What is wrong with this statement?" A good example to ponder is this Persian

WHEN TRAVELERS like Marco Polo voyaged afar to see the real animals, observation began slowly to come back into its own. The illustration at left is from a book, *Pilgrimages in the Holy Land,* printed in Germany in 1486. The artist guarantees the beasts to be "truly depicted as actually seen by us." But, though the long-eared goat and camel do show sound observation, the astonishing monkey and the unicorn mark this as a work of the transition period

THE INVENTION of printing helped immeasurably to spread the idea of observation among animal painters. The woodcut of wolves at right illustrated *The Garden of Health,* originally printed in 1485. Crude in artistic effect, these animals were nevertheless drawn from life, and the book ranks among the first natural histories in the modern sense



Courtesy of the Pierpont Morgan Library

author's belief that a female elephant can have only one offspring in the course of her whole life.

"The mountain goat," says the author (probably referring to the ibex in this instance), "leaps down from high places and lands unharmed standing on his horns. He breathes through his perforated horns; if the holes are stopped up, he shortly dies. The number of joints in his horn corresponds to the number of years of his age. He takes care of the female by bringing her grass and water in his mouth." The chestnut about the goat—or often a sheep—that lands unhurt on its horns is still a living bit of folklore and is solemnly repeated every summer to tourists in the Rocky Mountains.

The artist did not fall into the author's mistake about the animal's mode of breathing for he drew it with imperforate horns and normal nostrils. Indeed the artist in general was incomparably in advance of the text scientifically because, as a rule, he had bothered to look at the animals, and the author evidently had not. For his time, this was a remarkably realistic attitude, for since the days of the Egyptians and the Greeks few men had taken the trouble to look at nature. This anonymous but excellent artist made competent, recognizable paintings of all the animals accessible to him. Still more surprising, and a step ahead of much of the otherwise superior ancient work, is the fact that he has placed most of the animals in natural surroundings. These are among the first habitat paintings, lineal ancestors of the Museum's habitat groups. Only when the text calls for an animal for which the artist could not possibly obtain a model does he go astray, as in the ostrich and hippopotamus already mentioned.

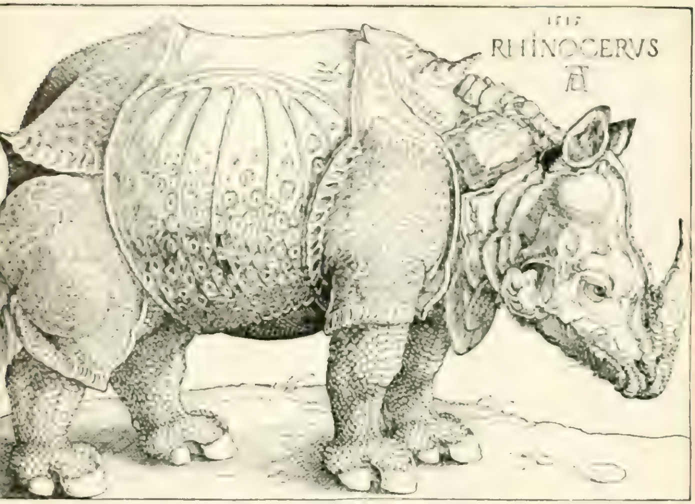
In a few cases the text describes an animal that was completely imaginary, as this careful artist must well have known. One can see him shrugging his shoulders and saying in medieval Persian, "Oh, well, let's shoot the works!" The result is his dazzling picture of the simurgh, a wonderful beast that lives (so the less critical author assures us) in fastnesses never penetrated by man. An owner of the manuscript, even more a scientist than the artist, has jotted in the margin, in the beautiful Persian script, "Thou fool, if nobody has seen the simurgh, then how dost thou portray it?" This marginal note by an unknown skeptic, long dead, should be framed and kept constantly in view by everyone who aspires to be an animal artist. The first and last essential of scientific animal portraiture is to see the animal.

That one must see an animal in order to portray it was well known to the cave men, to the Egyptians, Assyrians, and Greeks, but it was forgotten by the medieval Europeans. They believed in authority, not in observation and reason. They studied nature in books, not in fields and forests. Most students were not merely unscientific, but anti-scientific. The European bestiaries of that period show that there was no science of animal portraiture.

A typical example, and one of the most attractive artistically, is the Morgan Library bestiary in Latin, painted and written in England in the second half of the twelfth century. The text is for the most part an adaptation of a Greek text of ten centuries earlier, which in turn was a hash of Aristotle, folklore, and superstition. The purpose is not to describe animals and their uses, like the relatively scientific Arabic and Persian bestiaries of about the same time, but to point a moral. A tigress, for instance, is bereft of her cubs by a hunter who drops a mirror as he flees. The tigress thinks her reflection is a cub and she fondles the mirror while the hunter escapes with the real cubs. The hunter is the devil and the mirror is the worldly pleasure with which he beguiles us while he makes off with our souls.

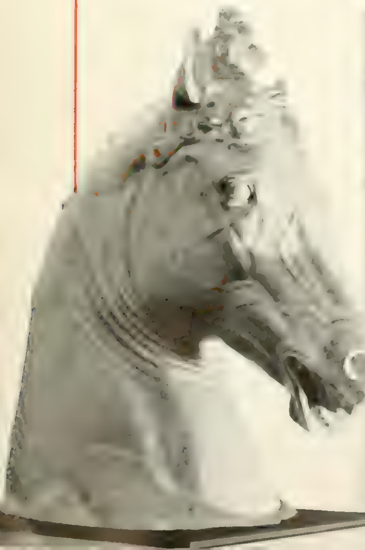
From a scientific point of view, the illustrations are on as low a level as the text. The artist seldom gives any evidence of having seen the animals that he paints and never shows any concern for fidelity to nature. Many of his animals are figments of the imagination: the centaur, the unicorn, the leucrotta, the phoenix, the halcyon, and the cinomolgus. Here is the parandrus, a sort of horse-hoofed deer that changes its color at will, and the yale, which is not a bulldog but an antelope with swivel-mounted horns that can be pointed forward or backward voluntarily.

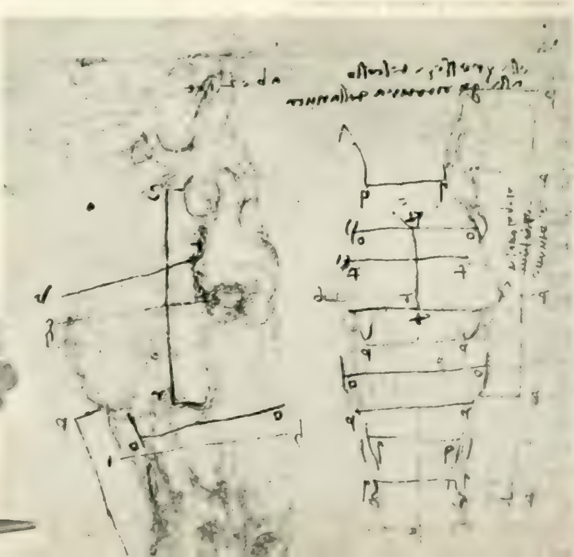
Many of these mythical beasts started out as real animals, and their transformation shows how little both artists and authors knew or cared for reality. The tiger, for instance, in one guise was called *martichoras,* a corruption of the Persian "maneater," later still further corrupted to the manticore

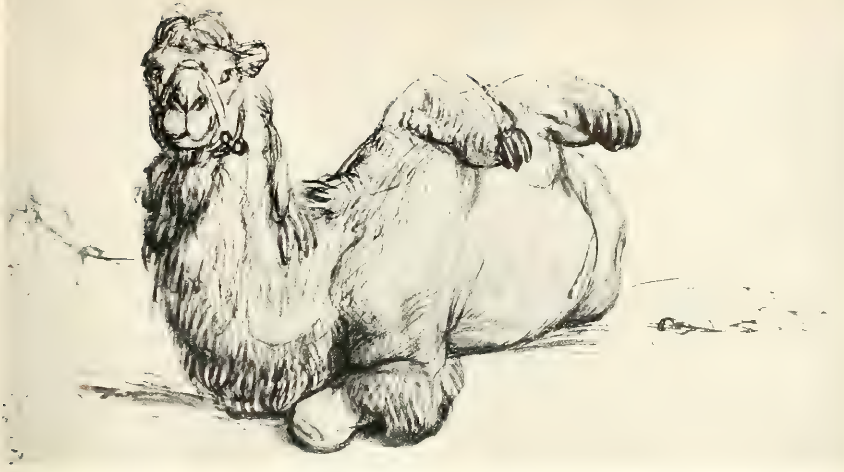


THE RENAISSANCE saw the rise of menageries in princely courts. These importations enabled artists to portray exotic animals in a realistic manner. An interesting result of this fresh stimulation is the rhinoceros at left, drawn in 1515 by the German painter and engraver, Albrecht Durer. The animal was the first of its kind to be brought to Europe (Portugal). Durer did not see it, but while the rhino was in Lisbon a friend of his made a sketch and wrote a brief description, on the basis of which Durer made his woodcut. Consequently, the outline and proportions are correct. But the skin, which he draws as if it were jointed armor plate with overlapping scales on the legs, betrays the fact that the artist never saw the creature in the flesh

THE WORK of Leonardo da Vinci (1452-1519) showed a return to the high standards of the Greeks and helped to usher in the modern period in animal art by combining personal observation, scientific accuracy, and artistic expression. His sketches, like those at right below, show how carefully he studied every detail of the anatomy and proportions of horses. Such studies resulted in triumphs of animal portraiture during the Renaissance, like the fine head modeled by Leonardo's teacher, Verrochio, and cast by Leopardi, shown below at left. This is part of the heroic equestrian statue of Bartolommeo Colleoni in Venice. Typical of much of the work of the period is the fact that the horse is only part of a larger composition in which a human figure dominates. The accurate portraiture of an animal for its own sake was still uncommon



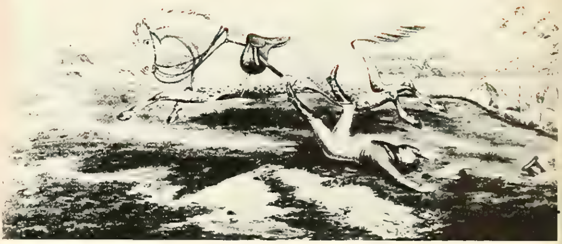




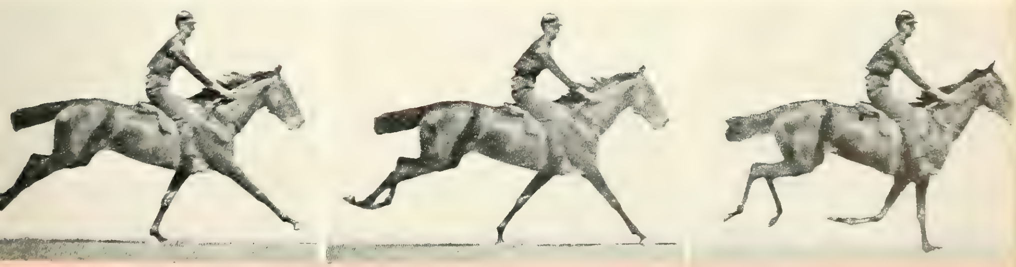
Courtesy of the Pierpont Morgan Library

THIS SKETCH of a camel by the immortal Rembrandt van Rijn (1606-1669) shows what a great artist can do when exotic animals are accessible in zoological gardens. Scientific animal drawing and painting was now on the track which carried it to its present status, as an art which is practiced by an increasing number of people and enjoyed ever more widely through development of techniques of printing. Even in Rembrandt's time and long after, however, animal art was lacking in one thing vital to the portrayal of animals as they are,—a knowledge of the animal's posture when it is in rapid motion

THE DETAILS OF RAPID MOTION often escaped the eye of even the most careful artist, as can be seen in the Currier and Ives print at right. Note that the horse is represented with all four hoofs off the ground at the moment of greatest stretch. This is altogether wrong, although many persons familiar with horses might argue that they have seen it. It remained for Eadweard Muybridge to correct many of the fallacies concerning animals in motion, in his classic book containing many photographic series, one of which is reproduced below. The older drawings were artistically valid in conveying the feeling of rapid motion in a single still picture. Perhaps they did this more successfully than does any one of a series of photographs, but they were impressionistic rather than realistic. The high-speed photographs reveal the scientific facts, and from them the modern animal painter has learned the postures actually assumed by animals at a given instant



From Animals in Motion, by Eadweard Muybridge



[illegible] bird's feet, and a saw-like row of spines on its back. The text assures us that this creature incontinently [illegible] ing for its victim. Of course this is introduced to [illegible]

The drawings in the European bestiaries are often spirited and amusing and they well account for the popularity of such works. In entertainment value they are almost on a par with the delightful illus- [illegible] serious scientific value is about the same.

A slow change for the better in European animal art began to appear toward the close of the Middle Ages and during the Renaissance. The first influence in this change was increased travel and exploration. Men who had seen crocodiles at firsthand were not satisfied with entirely imaginary drawings labeled "crocodile." It is true that at first the animals of [illegible] a medieval bestiary. The most popular travel book of the fifteenth and sixteenth centuries was that supposedly by Sir John Mandeville (even the author's name was false), which embellished a minimum of personal experience with a wealth of nonsense compiled from the least reliable parts of a large number of unreliable sources. The pseudo-Mandeville's description of the hippopotamus, for instance, is not designed to check the imagination of the artist:

"In this land there are ypotains [hippopotamuses] [illegible] are halfe a man and halfe a horse, and they eat not [naught] but men, when they may get them."

"Mandeville" not only thus made real animals monstrous but also solemnly confirmed the reality of mythical monsters like the griffin with "the body before as an Egle and behind as a Lyon, and it is trouth, for they be made so." People readily give a reputation for truth to a man who repeats familiar lies and will call a man a liar if he speaks unfamiliar truth. "Mandeville" was acclaimed for confirming erroneous beliefs about the East, while Marco Polo's name became almost a synonym for unreliability because he told, with general accuracy and restraint, what the East was really like. He mentions griffins and other fabulous animals, but with the careful statement that he, himself, had not seen them, and what he did see he related truthfully. For instance the giraffe, to Marco Polo, "is a handsome beast. The body is well-proportioned, the fore-legs long and high, the hind-legs short, the neck very long, the head small, and in its manners it is gentle. Its prevailing color is light, with circular reddish spots. Its neck, including the head, is three paces." These are the words of a man who was trying, albeit a little clumsily, to give a true account.

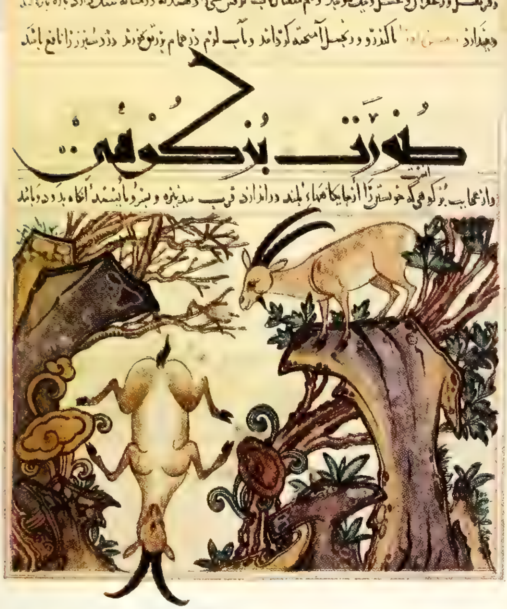
Travelers did eventually become acquainted with most of the real animals that had been only names to Europeans, and they did slowly reach the conviction that the griffin and other mythical creatures were nowhere to be found. Other important factors in the improvement of animal art were the rediscovery of ancient art and a great change in the attitude toward learning and its illustration—realization that "thou canst not portray the simurgh" without seeing it. The close observation and brilliant technique of Greek sculptures of animals inspired the artists of the Renaissance to follow the same methods. An awakened spirit of inquiry, stimulated by Arabic science among other things, led to the desire to draw animals as they really are and for the purpose of conveying accurate knowledge. In short, true scientific illustration of natural history began to appear in Europe for the first time.

The beginning of this new era almost coincided with the invention of printing, which helped greatly to spread the new methods and their results. Some of the earliest printed books included pictures and descriptions of animals. A landmark in this new development is the *Hortus Sanitatis* ("Garden of Health") printed at Mainz by Peter Schöffer in 1485 (a fine copy is now on exhibition at the Morgan Library). Its woodcuts are crude and cannot compare with a good bestiary in artistic effect, but they were evidently drawn from life and they are serious efforts to show the readers what the animals really looked like. A later edition (1491) greatly increased the number of animal portraits and deserves to be ranked among the first illustrated natural histories in a modern sense.

The same happy tendency and its limitations are shown in books of travel of this later period, after Mandeville and Marco Polo, such as Breydenbach's *Peregrinationes in Terram Sanctam* ("Pilgrimages in the Holy Land"), printed at Mainz in 1486. An artist, Erhard Reuwich of Utrecht, accompanied the author and made drawings of exotic animals from life, "truly depicted as actually seen by us." His claim must be true for the camel and long-eared goat. His giraffe and crocodile inspire less faith in his actually having seen the animals, but are recognizable and far better than most of the previous European illustrations of these animals. The monkey (not "ape"), whose name he did not know, may be from life but if so is poorly drawn, and his boast of complete veracity is violently contradicted by the inclusion of a unicorn!

While artists like Reuwich were beginning to go to the animals to study them, the animals were also being brought to the artists. The Renaissance saw the rise of menageries or zoological gardens at many places in Europe, and the princes of the period often had collections of live animals, portraits of which became increasingly frequent in the work of the best artists. Perhaps the best known of these is Dürer's woodcut of a rhinoceros, although it happens to be a belated example of imperfectly scientific animal art. The model, said to have been the first rhinoceros ever seen in Europe, was imported from India by King Emanuel of Portugal, in May, 1513. The animal was intended as a gift for the Pope, but it perished in a shipwreck. Dürer did not see it, but while it was in Lisbon a friend of his made a sketch and wrote a description, the quality of which can be judged from the text published with the woodcut:

"It has a color like a speckled turtle and is strongly enclosed in a thick shell and is as big as an elephant

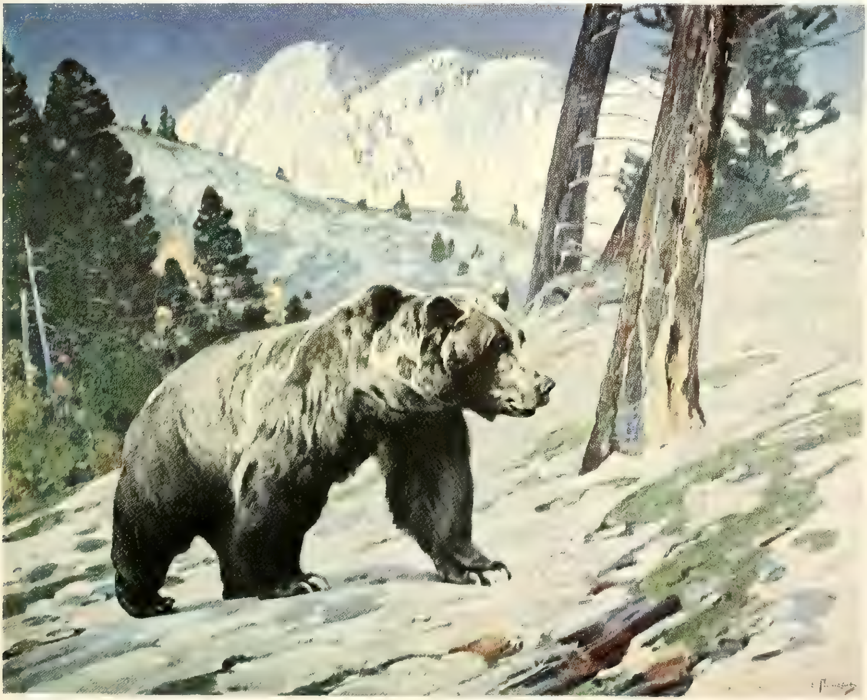


Courtesy of the Pierpont Morgan Library

INCORRECT ANIMAL ART is to blame for the perpetuation of many false ideas. The artist of the Persian bestiary from which the illustration at left is taken, drew the animals with reasonable accuracy. But he forsook his powers of observation when he succumbed to the picturesque notion that the ibex and the mountain goat fall unharmed on their horns,—a superstition that still persists in some quarters today. Through the centuries, with occasional setbacks, the purpose of the animal artist has grown stronger to reproduce nature as it is, to portray the wonders of life in all their real grace and beauty

AS AN EXAMPLE of the highest type of artistic realism in the portrayal of animals, Carl Rungius' painting of a silvertip grizzly is reproduced below, chosen from a number of works by this celebrated artist. The effect of this type of portrayal, which is executed with obvious power and precision and presents accurately the customary vegetation and background in which the animal lives, is to give the beholder an intimate impression of the personality of one of the earth's great creatures

Courtesy of the N. Y. Zoological Society
From a Kodachrome by Charles H. Coles



[illegible] sively.”

[illegible] of the nature of the skin, which he draws as if it were jointed armor plate, with overlapping scales on [illegible]

At about this time, the end of the fifteenth and beginning of the sixteenth centuries, the new spirit of [illegible] Leonardo da Vinci. As in so many other fields, his genius in animal art was far ahead of the time, and he made elaborate and often beautiful studies of the proportions, musculature and other details of common animals, especially horses. In this he had able though lesser followers, [illegible] often splendid animal portraits, suggestive of the Greek tradition that inspired them. The animals, however, are usually subsidiary parts of a more extensive and more human whole. They are elaborated details of some decorative painting or monumental sculpture—not scientific illustrations.

Some of Rembrandt's sketches of captive exotic animals, such as camels and elephants, in the seventeenth century, show a great artist conscientiously recording the true appearance of an animal. Thereafter scientific animal drawing and painting, with one exception, neither made nor needed any significant advance in method or in skill, much as they have advanced in the range and variety of subjects covered.

The exception lay in the drawing of animals in rapid motion, the details of which often escaped the eye of the most careful artist. An example familiar to everyone is the representation of galloping horses with all four legs extended. Running animals in Stone Age drawings are sometimes shown this way, and this mistake, as ancient as art itself, is almost universal in animal art until our own days. The pose is artistically satisfactory: it conveys the sense of motion that the artist felt. But it is scientifically incorrect: animals do not really assume this attitude at any one instant while in the act of running.

It was photography that solved this last problem and raised animal portraiture to the peak of perfection now attained. Eadweard Muybridge's experiments, instrumental in the invention of motion pictures, were especially directed toward finding out exactly how animals do move, and they showed that almost all drawings of animals in rapid motion had been incorrect. In the hands of many expert photographers and explorers like Carl Akeley and Martin Johnson, the camera has now recorded an enormous variety of animals, both still and in motion, in their native surroundings. The recent extensive use of color photography has made scientific records that are well-nigh perfect and that compare with the bestiary miniatures, for purposes of scientific illustration, about as a hydroplane compares with a dugout canoe, for travel over water.

There seems to be no memory of the name of the genius who first decided that the best possible record of the appearance of an animal would be the animal itself, or at least its skin, filled out so as to imitate life. This is a relatively recent development, and really serious efforts at taxidermy for scientific purposes were probably not made before the eighteenth century. That even this method is subject to falsification is shown by what must be one of the oldest extant mounted animals, a hare formerly in the “Curiosity Cabinet” of the Duke of Wurttemberg, Germany, and at last accounts still preserved in the Natural History Museum of Stuttgart. Its peculiarity is that it has a pair of well-developed horns, which were, of course, ingeniously inserted with intent to deceive. This legend of the horned hare goes back to the bestiaries and earlier and is still alive. A few years ago in Montana I saw a very small mounted horned jack rabbit, a hoax by some local taxidermist who surely had never heard of the Duke of Wurttemberg and did not know the respectable antiquity of his joke.

The museum exhibits of animals in the nineteenth century were literally stuffed, a word that makes a modern taxidermist cringe. The technique was to take a skin, stuff it full of straw or the like, sew it up, attach black shoe-buttons for eyes, and stick it in a case with others of its sort. The result was usually a travesty of the original animal, far exceeded in scientific value by contemporaneous paintings of animals. Some efforts were made to show animals more realistically and in action, but they were rare. The masterpiece of the old school of taxidermy was one of the original exhibits of the American Museum and was thus described in the *Evening Post* (when William Cullen Bryant was Editor) at the time the Museum was first opened to the public in 1871:

“The object most certain to strike the eye of a visitor is a group of animals mounted by M. Verreaux for the Paris Exposition, where it was awarded a gold medal as the finest specimen of the taxidermist's art. It represents an Arab mounted on a camel attacked by a lion and lioness. The lioness has been shot and lies dead upon the ground, while the lion, reared upon its hind legs, grapples both the camel and the rider, who is in the act of aiming a blow at the monster with his knife. The camel, with head bent back, is apparently uttering a cry as the claws of its assailant sink into its flesh. The Human figure is of wax, while the animals, of course, are the real beasts, admirably mounted.” (That the human figure should be wax was not inevitable at that time. Human skins were sometimes stuffed for exhibition. A few years ago in the great Natural History Museum of Paris I saw the mounted skin of a Hottentot belle, formerly on exhibition but withdrawn behind the scenes when she began to crack.)

Taxidermy has since advanced almost unrecognizably. The skins are no longer stuffed but are mounted over a cast and sculptured base faithfully representing every detail of the play of muscles. The surroundings of the animals are also reproduced with complete accuracy and the groups arranged in internally lighted cases with painted backgrounds. A scientifically exact, three-dimensional piece of the animal's home is transplanted into the museum, and the animal is placed in it as if frozen in a living pose. Here, as far as we know, is the end of the long story and the culmination of the slow evolution that began many thousands of years ago in the caves of Stone Age France.

THE MYSTERY OF THE FIG

The natives said they hung wild figs in the orchards to keep away the evil spirits

Wasps are now being raised by the million to fertilize the domestic figs

By PAUL BULLA *with illustrations by* LAURENCE BLAIR

The Smyrna fig is a lady, and that is why the natives could raise luscious fruit and the Californians only shriveled buds. But a scientific Odyssey spanning two continents was necessary to solve this amazing riddle, in which a tiny insect became one of the most pampered passengers ever to cross the Atlantic

SINCE long before the Pilgrim Fathers stepped off the boat, our forefathers have been sold on the idea that the shortest distance between two points is a straight line. That is axiomatic; or is it? Mother Nature might give you an argument.

"If I plant an Irish potato," you say, "I will have spuds sooner or later. And that little seedling out back will most surely bear apples some day, or I'll be amazed."

You are probably right. But did you ever try raising Smyrna figs? If by any chance you attempted that feat you must have reached the conclusion that you had been going nowhere and had arrived. And you were right again. No edible Smyrna figs grew on your tree because you were all out of everything that makes them flourish and develop into the delightful fruit you know. All you had was the fig tree, and Mother Nature was detouring just for the fun of it.

It so happens that Smyrna figs are the finest in the world, but they are not native to America. This fact, however, meant less than nothing to us after we had acquired an appetite for them. They grew in Turkey, so why not here? Why pay a tariff to Turkey when our Southern California climate was made to order for this fruit? That seemed to be good, straight reasoning.

Back in 1882 Julian P. Rixford, Business Manager of the San Francisco *Bulletin,* aided by the United States Consul at Smyrna, imported 14,000 cuttings of true Smyrna fig trees into California. These *Bulletin* cuttings were widely distributed as goodwill offerings among the subscribers to that newspaper. With much publicity and fanfare they were planted. Then the importers and recipients sat back and awaited results—and it turned out to be quite a wait.

The cuttings flourished and four years passed, but there were no figs. In the third and fourth years tiny, shriveled buds did appear, but these withered and dropped from the trees before maturing. There was dismay in the orchards. Here were fruit trees that bore no fruit, trees whose leaves apparently failed utterly to intercept the rays of the California sun. The conundrum did not tend to increase the advertising value of the *Bulletin* venture.

An appeal was made to the United States Department of Agriculture for aid, and a scientist was sent to the Near East to discover why Smyrna figs worked for the Turk but "soldiered" in America.

When our investigator arrived, he was able to piece out the curious story which was already known in some of its details and to pave the way for a successful industry in California. He found not only many orchards of trees bearing Smyrna figs, with their rich, sugary pulp and nutty flavor, but also a wild fig tree whose fruit was known as "caprifig." This fruit, small and hard, was never eaten. When these caprifigs were mature, the natives would gather them and, looping them on strings, hang them in the orchards that produced Smyrna figs. This was done, they explained, to keep evil spirits from destroying the fig crops. The mental processes of our scientist were not short-circuited by this tale. He had learned soon after his arrival that the natives were violently opposed to

[illegible]

[illegible] the wings of many were torn from their bodies. After [illegible] where they quickly died.

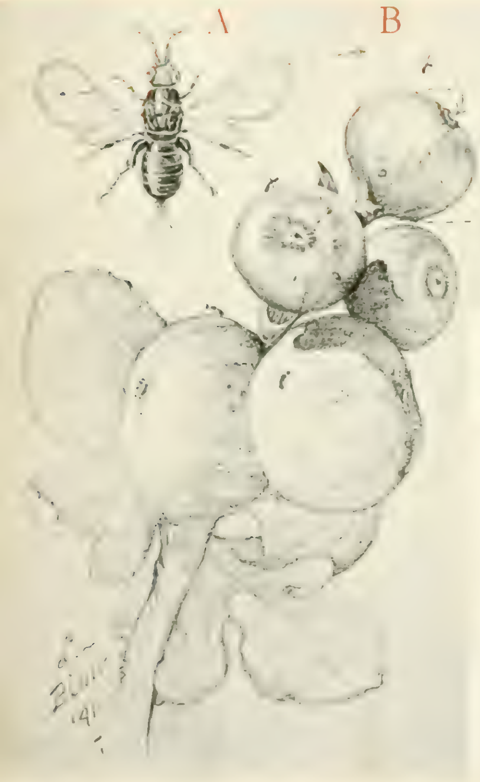
On opening one of the figs the scientist verified the [illegible] it was not a fruit at all but a pear-shaped bowl containing dozens and dozens of flowers. Inside this bowl were tiny pistils but no stamens, which proved that the Smyrna fig was exclusively female and produced no pollen.

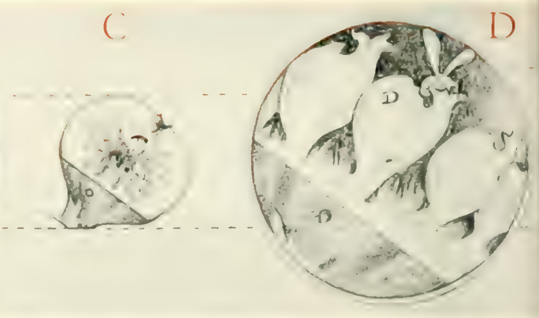
Further investigation revealed that the caprifig with its stamens was the male variety, and while it was inedible it yielded an abundance of pollen. If these tiny flowers within the floral cavity of the Smyrna fig were not fertilized by the pollen from the caprifig, seeds would not form, and the fruit we know would not develop. Our scientist was no longer confused. The strange metamorphosis of a flower into a [illegible] than the little insect magician, burrowing so frantically into the Smyrna fig, who had performed the function of pollination.

The female of this tiny wasp perforates one of the ovaries inside the caprifig and there deposits her eggs, for only in wild figs are these insects able to breed and survive. The presence of eggs in the ovary causes a gall to form about them, and it is in these galls that they develop. The male wasp is hatched out first. He has no wings and so never leaves the wild fig in which he is produced. When he is able to crawl about the floral cavity he punctures the gall in which the female is developing, and mates with her.

After the mating the female emerges from the gall and crawls about among the stamens, where she becomes covered with the pollen of the wild fig. Finally she finds her way out through a hole in the end of the fig and flies away, seeking another wild fig in which to lay her eggs.

In seeking such a place, the female wasp enters both Smyrna figs and caprifigs. As young wasps cannot live in Smyrna figs, it is mad instinct alone that drives the female to enter, mistaking this fig in her search for the wild variety. Many of these insects





When a San Francisco newspaper imported 14,000 cuttings of Smyrna fig trees to distribute as goodwill offerings, no figs grew. The ensuing investigation, which spanned two continents, revealed an ancient secret of fig culture. Plant, insect, and man work together here for the good of all three in a manner that makes this one of the most amazing examples of co-operation in all Nature.

A The imported figs did not grow because two things were lacking, a wild fig and the tiny wasp shown at upper left, greatly enlarged. The cultivated fig is exclusively of one sex, female. Having no pollen of its own, the fruit will not develop without pollination from a wild fig, the so-called caprifig. The fig is dependent on the wasp, and the wasp on the fig, for the wasp cannot produce a new generation without the fruit of the wild fig in which to lay its eggs.

B At left is shown the tiny wasp exploring the fruit of the wild fig for the natural opening through which to enter, indicated at top by an arrow. The wasps are here shown about natural size.

C Cross section of wild fig, with insect well within and ready to deposit its eggs.

D Inside the same fruit, this enlarged section shows the wasp about to lay its eggs in the ovary of the flower of the wild fig. In this act, the insect thrusts its egg-laying tube through the hollow reach the goal they seek—a caprifig—, where a new life cycle takes place. However, many others find their way into the Smyrna figs and thus give their lives to the benefit of mankind.

For within the Smyrna fig cavity the female wasp moves about, seeking a place to lay her eggs. She finds no short-styled ovaries in which these eggs may develop. But all the while pollen, which she brought from the caprifig, is falling from her body and fertilizing the tiny pistils within the fig. By this magic and the error of a tiny insect we are able to enjoy the honey-sweet fruit of the Smyrna fig.

After our scientist reported his findings to the Department of Agriculture, several attempts were made to bring the wild caprifig trees, with their cargo of insects, to this country, but all were unsuccessful. The difficulty that confronted the Department was in getting these insects to the United States before they emerged to seek a place to lay their eggs. For within the caprifigs the little wasps passed through their life cycle in two weeks. Without new and fresh caprifigs the insects could not survive; and there was no means of getting them to California within that time.

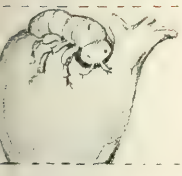
After four years the problem was solved. Wasp-infested caprifigs were collected in northern Africa, the nearest point to the United States where they were available. Wrapped in tinfoil to preserve the moisture, they were rushed to California. They arrived none too soon, for almost at once they emerged from the caprifigs and commenced to lay their eggs in the growing wild figs provided for them.

In four weeks thousands of fig wasps were hatched, and from then on they increased rapidly. Wherever Smyrna fig trees grew in California, caprifig trees, with their wasp-laden fruit, were grown nearby, and everywhere abundant crops of the rich, nutty fig were produced.

Today Smyrna figs, grown in California (where they are known as Calimyrna figs), are as luscious as those produced in their native land, but should some blight kill off all caprifigs, Smyrna figs would disappear from the earth.

The health of these small insects is of major importance to the fig orchardists on the Coast, not only because they are indispensable to the industry but because of the discovery that they may spread a brown-rot disease to the Smyrna figs from infected caprifigs. To prevent this the little wasps are being reared by the millions in sterile incubators and released in the orchards free from brown-rot germs.

E



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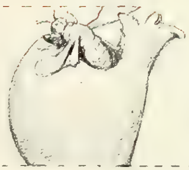

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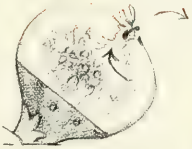

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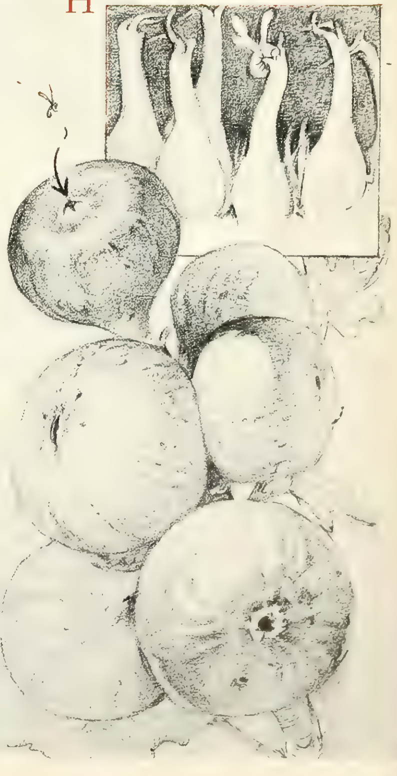


center of the neck-like style to the ovary. This operation is impossible in the edible fig, as the style is too long, as shown at H.

E When the eggs hatch and develop in the wild fig ovary, a male wasp must be present to fertilize the newly matured, imprisoned female. Here the male, a wingless insect, is shown gnawing a hole in the ovary.

F Now fertilized, the female escapes through the same opening and is on her way out in search of other figs in which to lay her eggs.

G In leaving, she becomes dusted with the pollen of the wild fig, which is grouped about the opening as indicated by the arrow. In this act, the wasp becomes the key to the Smyrna fig industry, for the Smyrna fig has no pollen of its own and will not bear edible fruit unless pollinated by this insect carrying it from the wild fig.

H The wasp, in search of caprifigs in which to lay her eggs, "blunders" into Smyrna figs. They do not serve her purpose, for she cannot lay eggs in their ovaries (because of their greatly elongated styles), but she serves man well. For in this act she pollinates the fruit, enabling it to develop into the valued product of commerce. Growers in the Near East were observed to hang strings of wild figs in their Smyrna fig orchards. Investigation of this curious custom revealed the intricate chain of events described here.

The Massacre of St. Valentine's Day

Strange things are bound to happen when an ancient Roman Fertility Rite is inducted into European society

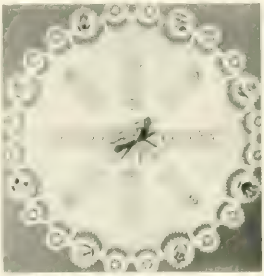
By D. R. Barton

W[illegible] it seems to roll along a tor[illegible] nacles and all manner of incidental accretions until the original shape and line is very nearly obliterated. Such, at any rate, appears to have been the [illegible] Day. Two Roman churchmen who had precious little to do with cupid's bow, or with each other, have given the day its name. But their biographies offer so unreasonable a basis for the general character of the celebration that scholars have digressed into a variety of byways seeking explanations a bit more on the amatory side. Etymologists have suggested that v and g are often interchangeable in popular speech: that "valentine" may be derived from the French *galantin* (gallant) and that the name of the two saints came to be applied more or less through the repetition of an error in proof reading. It is also barely possible that the old English "voluntyne" might be a Latin derivative meaning "willing love" or something of the sort. However, neither explanation is particularly satisfactory.

As for the saints themselves, the first Valentine was a martyr, but not to love. He was executed during the Christian persecutions promulgated by the Roman Emperor Claudius. The other Valentine died most unromantically when he choked on a fishbone. It is generally agreed that the feast day named in their memory stems from the pagan rites comprising the Lupercalia, [illegible] part calculated to conjure fertility and easy delivery among women, which, in ancient Rome, were celebrated each February in honor of the deities, Pan and Juno Februata. All this, of course, went on for a good many centuries before either of the saints was born.

For some reason or other, one feature of the Lupercalian ceremonies called for the jumbling of young ladies' names in a pot. These in turn were drawn by all the young men, the idea being to find out who was going [illegible] year. Whether this was a means of divination or simply a lottery is not clear. But it does seem that the young gallants of old Rome penned nothing in the nature of:

[illegible]
life,
[illegible]
wife."



Nineteenth-century lovers sent delicate, hand-cut valentines

The custom was a literal embodiment of "the marriage lottery." But matrimony apparently was never mentioned.

However, the pastors of the early Christian church soon began working overtime to eradicate pagan superstition and particularly the pagan moral code. They knew—or presently discovered—that these ancient and deeply rooted modes of behavior could not be utterly abolished. Therefore, as with nearly all of the pre-Christian feast days absorbed in the Church, they sought to apply an over-layer of *post facto* respectability. Transforming the earthy gaiety of the Roman festival into an otherworldly lesson in piety, they substituted saints' names for those of buxom lassies. Each saint became a patron for the coming year, serving as model for the daily behavior of whoever pulled his name out of the pot. This Procrustean distortion of custom must have strained many a young man's patience—imagine drawing the scabrous St. Simeon Stylites in lieu of [illegible] before something like the original practice bloomed again.

Yet, when it began to reappear, the Church had at least won a point. For superstition now emphasized that every girl who was drawn stood an excellent chance of marrying the boy before the year's end. And the girls had also won a point. Their place was no longer exclusively in the pot and they, too, were privileged to draw names. The lottery became coeducational and therefore highly complicated. Everyone had *two* valentines: the one you drew and the one by whom you were drawn. Custom dictated that you owed most of your allegiance to the former. But the complexities of the situation in a monogamous society can readily be seen.

Fertility rites and Semitic monotheism simply don't mix, and though Valentine's Day survived as a kind of bootleg Lupercalia, the Church had so adulterated the mixture as to deprive it of most of its original vigor. The ritual gradually lost dignity and degenerated, seemingly in response to the inherent confusions and contradictions. Medieval France yields a significantly garbled example. Here the practices corresponded to our mock marriage and were inextricably bound up with the ancient Lenten fires. This is what happened. The names of various young people were called out in pairs as they assembled around the bonfire. Obviously the barker or master of ceremonies, out for a laugh then as now, would strive to hit upon the most grotesque combinations possible so that all serious values were jettisoned. The ritual required an exchange of gifts between the couples, and in this exchange we discern the long arm of Mother Church. The presents were called *rachat* (ransom or redemption) and were supposed to redeem the whimsically paired valentines from the flames of the (eternal) bonfire. Any pair which failed to give presents was burned symbolically in small fires kindled at their doorsteps.

From this it would appear that the custom of exchanging presents on Valentine's Day was originally a matter of souls rather than hearts. Of course, we don't exchange today—it's only the man who pays—but this restriction is a heritage dating from the England of the Stuart Restoration, when an elaborate spirit of courtly gallantry sprang up in the wake of Puritan reformism.

Chance or choice

Valentine's Day has undergone so many local modifications that it is very difficult to discover anything resembling a straight line of development, even when we confine our attention exclusively to England, where counties and shires differed markedly in their methods of celebration. One thing seems fairly clear, however. If the festival were to have any real significance as an institutionalized means of seeking a mate, Choice would sooner or later have to supersede Chance. On the other hand, if the day were set aside for the purpose of taking auguries, then Chance would naturally remain in the saddle. And, for a time at least, it did.

The persistent—and probably clerically inspired—superstition that your valentine would eventually become your wedded husband gave rise to a variety of ways of ascertaining his identity beforehand. For example, a young woman would enter the churchyard on St. Valentine's eve, wait until the clock struck twelve, and then run twelve laps around the church, declaiming:

I sow hemp seeds, hemp seeds I sow,
He that loves me best come after me and mow.

According to tradition she scattered real hemp seed, expecting to see the image of her future spouse puffing after her through the gloomy night air. Equally bucolic and perhaps even more liable to misunderstanding was the unmaidenly custom of peeping through keyholes before opening doors on Valentine's Day. If the damsel spied a cock and hen in company, it was a good omen that she would marry before the year was out.

Dreams have always been interpreted as prophecies, and the divining of a future lover's identity by inducing nocturnal fantasies scarcely comes as a surprise. Devonshire girls once picked yarrow from a man's grave repeating:

Yarrow, sweet yarrow, the first I have found,
And in the name of Jesus I pick it from the ground.

The yarrow was then placed under their pillows before retiring. Or they might cross their shoes in the form of the letter T, saying:

I place my shoes like the letter T
In hopes my true love I shall see
In his apparel and his array,
As he is now and every day.

We have a record of one eighteenth century young lady who took extraordinary precautions to ensure dreaming. She pinned four bay leaves at the corners of her pillow and placed a fifth in the middle. Then, hard-boiling an egg, she removed the yoke, filled the cavity with salt and ate it shell and all without speaking or drinking afterwards. Unfortunately we do not know precisely what images this gastronomic feat caused to appear in her sleeping mind. One would surmise, however, that she took sanctuary in the nearest nunnery.

The means of divination on Valentine's Day were legion. One of the simplest and apparently the most prevalent is handed down to us in a verse of the poet John Gay:

"Thee first I spied, and the first swain we see
In spite of Fortune shall our true love be."

Accordingly, Pepys, in his immortal *Diary,* records that he laughed heartily, one Valentine's Day, because his wife had to sit all morning with her eyes shut for fear of spying one of the house painters who had come in to redecorate the apartment. Evidently valentines had by this time lost their significance as courtship overtures. They were valid for one day only, and it made no difference whether you were married or not. Both Pepys and his wife had valentines, the latter being claimed by a little shaver named Will Mercer, who is judged to have been about twelve years old, and who presented her with the first illustrated valentine ever mentioned in English literature. It was about this time that the custom of giving presents began to decline. Some of the gifts were very expensive, and apparently the game hardly seemed worth the candle. Gallants reneged at squandering jewelry worth several hundred pounds on some lady whose attachment was fleeting and purely ceremonial.

The festival had become avowedly artificial. Even writers of the time were alert to the decadence, and Lord North wrote: "A lady of wit and quality . . . would never put herself to the chance of a valentine saying that shee would never couple herself but by

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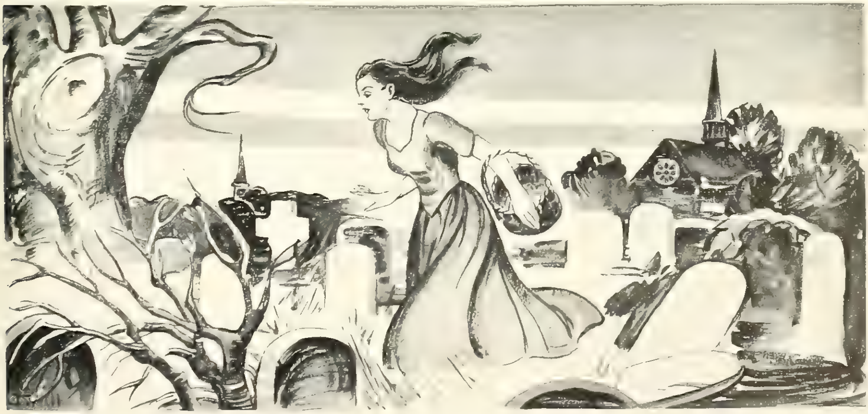


A LYNX IN THE HOME

By Isabel Harper Blount

With photographs by the author

GERONIMO at six weeks (*above*) and at four years (*below*). Originally hailing from Arizona, he was named in honor of the Apache chief. When found, he weighed only 1¼ pounds and could not walk

A RUBBER SYRINGE proved an ideal milk bottle, until Geronimo began to use the syringe as a squirt gun. Early tantrums were stopped by grabbing him by the scruff of the neck and the "seat of the pants"

The story of Geronimo, a bay lynx, who enjoys life in city apartments, hotels and Pullman trains: 29 pounds of wildcat made tame and affectionate

It was over four years ago that we adopted him—a bay lynx. Two kittens about two weeks old had been taken that day from a cave in the vicinity of Carlsbad Caverns and were offered for sale at a local store. We chose the smaller, which weighed one and a quarter pounds, because of the beautiful symmetry of his markings. And so we found ourselves suddenly the proud but rather solemn foster parents of a very strong personality. His eyes, though open, evidently could not yet focus accurately, and his hindquarters collapsed when he tried to walk. But his large head, broad chest and low-pitched growl gave an impression of vigor and determination.

The low, gurgling growls and faint but unmistakable efforts to spit continued throughout the first night. Every two or three hours we attempted to feed him diluted evaporated milk, either with a spoon or by a soaked cloth wick; but he struggled and consequently got very little. It was not till two days later, when we were able to obtain a tiny wide-mouthed doll's nursing bottle with a suitable nipple, that he began to get enough to eat.

After three days away from his mother he had received almost nothing, but he seemed to have grown in strength, and the feeding process every few hours was quite a feat of patience on everybody's part. The kitten was wrapped firmly in a towel to secure his hind feet, and held on his back. Since the nipple had to be kept on with the fingers, the sharp little teeth went under our nails, and strong paws with claws exposed pushed against our hands. But the kitten grunted and worked hard with evident pleasure, and we felt that the first step in his upbringing was accomplished. We soon began giving him small pieces of meat, which he licked and sometimes swallowed.

We traveled five days by car, and each day he gained in size. The growls and spitting had ceased after the first night. On the fourth night we were surprised to hear a loud and insistent voice calling to us from the next room in a tourist cabin. Upon entering we found he had climbed out of his box and was staggering across the floor in our direction. After this he always came to meet us when we entered the room, giving a trill of greeting, "Brrrrt." He also often trilled when he was covered with a towel.

We had named him Geronimo in honor of the famous Apache in whose territory he was born.

For a bus trip from Phoenix to Minneapolis a young lynx needed a comfortable basket with a lid, and a good-sized nursing bottle. Ultimately we found such a basket with a small padlock to secure it; and in a drugstore my husband's eye discovered a three-ounce rubber ear syringe, which proved to be ideal, since it was self-filling and required no separate nipple.

At the start of the bus journey we decided to make Geronimo as inconspicuous as possible. The moment he woke and cried we popped the syringe into his mouth, and he eagerly drained it. From then until he slept again we tried to keep him from climbing to our shoulders where he could be seen in the driver's mirror. While one of us played with him the other spread [illegible] very sympathetic. Fortunately at first there was a [illegible]

[illegible] could buy milk, rinse and fill the syringe, and eat something ourselves if there was time.

We had some trouble getting Geronimo to sleep in time to take the bus at five in the morning. During the thirteen-hour ride to Denver we were observed [illegible] his painful duty to report this to the driver. At Trinidad the latter explained that animals were no longer permitted on buses. We argued that since Geronimo had been allowed to start he should finish his journey, and accordingly he proceeded, but only in the baggage compartment. The steward surreptitiously brought him out at all lunch stops, and the kitten would then give a loud squeal of mingled indignation and pleasure.

[illegible] first signs of fear we had seen in Geronimo, although he must have been about three and a half weeks old by this time. During our six-hour wait in this city the kitten was well treated in the barber shops and hotel lobbies. A great deal of the time was spent on the steps of a church where we thought up suitable answers to the remarks of the Veterans of Foreign Wars, who were swarming in the streets. In their condition a milk bottle seemed more out of place than a wildcat.

In Omaha it was a relief to see Carlsbad, our box-turtle, and Geronimo wander at will in a large hotel room with an electric fan overhead, and this rest was [illegible]

At Sioux City we almost missed the bus while we played with him and tried to tire him into sleeping. [illegible] ing and the bus was starting, he suddenly gave in and we stepped aboard. That evening a fresh, cheerful little lynx who was rapidly outgrowing his basket, and two people worn out by the six-day effort at smuggling finally reached home. As we left, the driver [illegible] "Oh, I thought so," he said.

[illegible]

It was necessary to begin some sort of training, for we did not want Geronimo to become so badly spoiled that he would be an impossible house pet. We wanted him to realize that he was a member of [illegible] keenly his own importance and responsibility, especially if he is endowed with as much intelligence, energy, and alertness as the lynx possesses. From the first, Geronimo took himself seriously and felt so strongly on all subjects, that it was lucky he proved to be bright and teachable.

First the kitten was housebroken to the use of a pan, and this took only two lessons. In fact he got the idea only too well and kicked the sand with all four feet all over the room until the pan was empty. We found that pebbles were better than sand for such a vigorous kitten.

Geronimo soon grew big and strong enough to climb onto chairs, sofa, and bed. Once in the middle of the night, long after he had retired to his basket as usual, we heard a piteous outcry. He had managed to scramble to the top of an old-fashioned canvas trunk and was frightened because he was unable to get down. This showed what he could do, so it seemed necessary to train him in regard to the furniture. To exercise and to see from the windows he was allowed on certain pieces, but forbidden on others. At first he was taken from the latter and set on the floor, this action being accompanied by the word, "Down." Later when he clearly understood where he was not supposed to go and obeyed the command "Down," we began punishing him for infringement of these rules by slapping him on the thigh with the flat of the hand or a rolled newspaper.

[illegible]

Since he was exceedingly active, a place was needed where we could leave him when not being watched and yet where he would have plenty of room to move about. In the apartment only one such space was available—underneath the bed. So an enclosure with big gates was made of this whole area. The structure was suspended from the springs of the bed an inch or so above the floor to make it easy to clean under the edges. The strong wire mesh all round enabled him to see everything that went on about him. In this "house" were kept his dish of water or milk, his pan of pebbles, and a coconut to play with. As Geronimo grew, this pen had to be made higher and higher, until finally the bed was raised on tall posts with its [illegible]

From the beginning Geronimo enjoyed being sponged off with warm water. We soon began to shampoo him all over once every few weeks. In spite of a good deal of discomfort he puts up with the [illegible] bath drying and arranging his fur. If the bath is given when he is getting a new coat it hastens the shedding. We always give him a light meal before his bath so that there may be something in his stomach for the hair to collect upon and prevent the formation of hair balls.

Geronimo only gradually learned the self-control he now exercises. Not only was he pretty free at first in the use of teeth and claws, but he was quite formidable if he seized and defended some object we didn't want him to have. The first of these occasions arose when he began to chew up a sock and garter. When we tried to take them away, he went into a real tantrum. Finally he swallowed a good deal of both. The next tantrum occurred at about three and a half months of age and concerned the ear syringe from which he still took his milk. He was often annoyed when the milk didn't come fast enough to suit him, and also he had discovered the charm of chewing the tip, ruining several syringes in this way. Finally, while being fed in the middle of the night, he grabbed the syringe, which was full of milk, and jumped out of reach. When we tried to approach he shrieked and gave the syringe a squeeze, which squirted milk all over us. His failure to get milk in the mouth only infuriated him further; he yelled louder, squeezing harder and sending milk over window curtains, rugs, and furniture. Sitting up on his haunches he boxed with exposed claws, his little tail lashing and his eyes blazing. Only when we tossed some old syringes into the arena was he persuaded to drop the one still shooting milk. This was his last bottle feeding. The next time there was a tantrum my husband held Geronimo firmly against the floor by the scruff of his neck and the "seat of his pants" until he tired of screaming. After this there were no more genuine tantrums. Although he still likes to defend a towel or a new toy against our advances, it is really only a game.

Excitement for its own sake

Through his first year cod-liver oil was added to his food daily. He was usually given his meals in the kitchen at that time, and would refuse to eat, running back and forth between me and the food until I took up the position he wanted between him and the rest of the house, presumably to protect his rear against imaginary rivals for the meat. If my husband appeared, Geronimo responded with terrible growls and tail-switchings. However, when I went out of town my husband was accepted as a perfect substitute at meals. This, I think, serves to illustrate Geronimo's love of excitement for its own sake and the way he plays with his imagination.

During February and March Geronimo's second teeth came in, the process being completed when he was about seven months old. The four canines erupted before the first set were out, so that he had eight at once. As he was trying to get rid of the loose ones, we finally took them out for him with our fingers, and each time he was quite triumphant and congratulatory. During teething he began the practice of taking one's hand between his teeth and lying very still with his eyes closed. If one could stand the pressure he would finally go to sleep this way, but the pain was almost unbearable.

At about a year and a half Geronimo commenced something that the Persian cat fanciers had warned us about. Like a dog he began to leave signs about, marking especially his own house and the front door of the apartment. He was so proud of this new habit that it took patience and repeated punishment to break him of it.

Geronimo has never been mated, but shows a somewhat greater restlessness and excitability during the late winter and again during the late spring.

He has had but one illness. Before the age of a year and a half his jaws had become strong enough to make an impression on his hard rubber toys. He began to vomit frequently, and an X-ray picture showed a mass in his stomach. An operation was performed in a university laboratory; the stomach was opened, and hard rubber, sponge rubber, and part of a tennis ball were removed. The next week he allowed us to take out the stitches and in two weeks he seemed about as usual. The result of this has been to make us exceedingly careful about the toys.

What is now the daily life of our house-lynx at four years of age? Like a child he enjoys repetition and tries to keep us to a regular routine. When the alarm clock goes off in the morning, for instance, he is troubled if we do not get up promptly. My husband usually takes him with him to his bath, and Geronimo is so afraid of being forgotten that he utters several very clear, sweet notes when he thinks the time has come for this ceremony, and allows himself to be drawn from his house, sometimes by one foot, and carried off over the shoulder. As an afterthought he usually remembers that he may be sponged or dipped, and he alternately purrs and growls.

From the bathroom he watches for the milk trucks that supply the apartments in great numbers, hiding behind the curtains when they appear. He follows their progress along the street to a distance of several blocks, craning his neck and exhibiting real excitement. He understands that one of these brings his own milk, but pretends to think they are dangerous. After superintending the bath and shaving, he is glad enough to return to his house, groom himself with wet paws, and doze.

At noon Geronimo has a drink of skimmed milk and plays for several hours about the apartment. If he is in a quiet mood he may sit looking out of a window, or follow what goes on outside by moving from one window to another. Or he may lie on the elevated bed whence he can see along two streets. He misses nothing of what takes place even several blocks away, children and motorcycles exciting him most perhaps.

Ball games

If Geronimo is frolicsome it is best to give up what you are doing and let him have a good workout, otherwise he is likely to try to attract attention by going to forbidden perches, or merely threatening to do so, while carefully watching you for the effect. He is allowed to select the toy or ball he wants us to use, as several are kept in his carrying case to which he has access. If he sits down and gazes at a certain drawer where the tennis ball is kept when not in use, or chews our wrists or "tags" us, it means he wants to play one of several games of his own invention. He crouches around a corner somewhere with his hind feet well up on the wall behind him to give a better push-off, and as the ball comes past he pounces on it. Sometimes you wonder what has become of him, and then you realize that he has been patiently waiting for some time out of sight with his feet up behind him. There are several black spots on the wallpaper where he has done this habitually. In another game he waits for the ball under a chair or just around a corner with one eye and ear showing. Then instead of pouncing he shoots out one arm and rolls the ball smartly back. Often he will send it back half a dozen times so accurately that it is unnecessary to change one's position.

"Batting practice" consists of throwing the ball high to him as he sits on the bed. With a fine, free action at the shoulder Geronimo knocks it across the room with a resounding whack, using either the right or left paw. When he is really on his high horse he races back and forth without any ball, leaping from the bed, going round the davenport, and returning with as much noise as a dog would make.

One day we covered him with newspapers, saying, "Where's Geronimo? Where's the kitty?" He caught on to this game at once, lying very still for a few mo-

[illegible] He then receives our congratulations with evident pride.

Then there are the times when Geronimo just feels how good it is to be alive, when he "dribbles" a ball [illegible] he takes his coconut in his arms, rolls over on his back and passes the coconut from one side to the other over the top of his head. Or he may simply say, "Wunh," [illegible] him. When we write at the desk he repeatedly lands [illegible] there for some time, effectually preventing further [illegible]

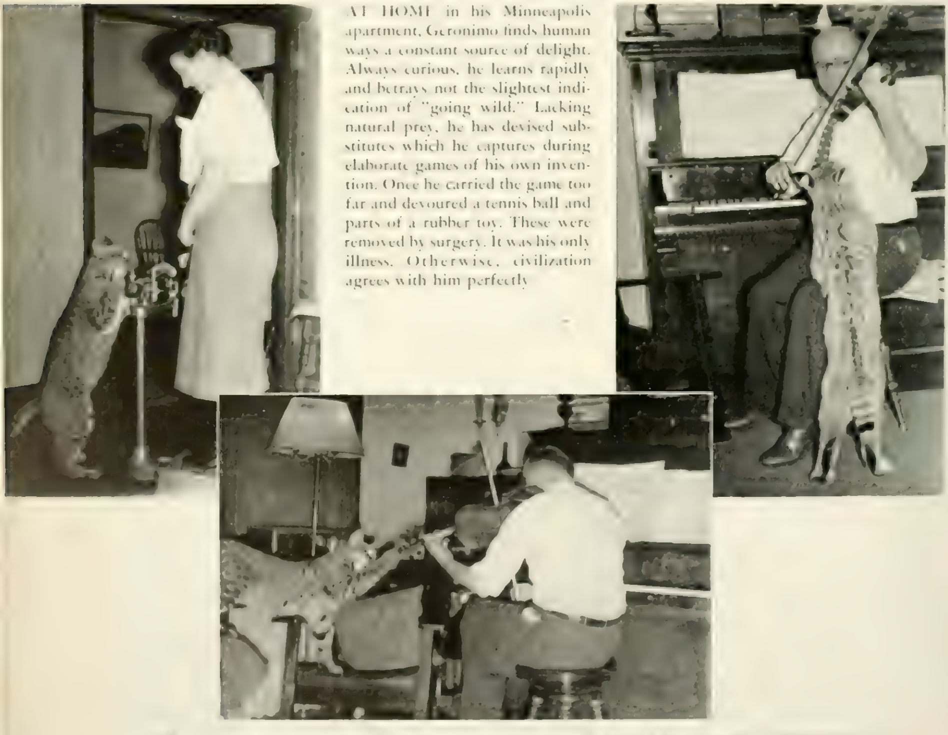
[illegible]

[illegible] tub and be allowed to play by himself in the bath- [illegible] there. During a recent heat wave one of us had drawn a deep, cold bath—but Geronimo got there first! He was standing up to his shoulders in the water, hissing with nervousness, his eyes big and black. Fixing them on our faces and breathing hard, with whiskers forward and growls of discomfort, he gingerly lowered himself "to his elbows" but not clear down.

After his own dinner Geronimo likes to superintend the preparation of ours. He has been allowed to taste anything he has a mind to try, with curious results, as he has bitten into an onion and a grapefruit with consequent disillusionment. This experience taught him to carry grapefruit and lemons without biting into them. Celery intoxicates him just as catnip does; he rolls on it and becomes strongly perfumed with it. He is really enthusiastic about ripe olives. No bouquet of flowers is safe for a minute, his favorite [illegible]

[illegible]

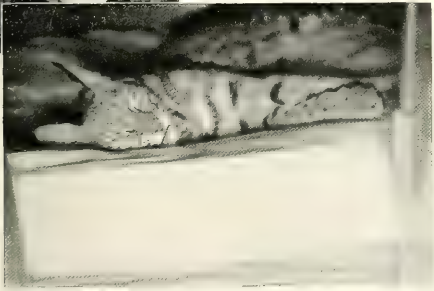
[illegible] turn from work so that he can rush out, jump to his shoulder and caress his head. During the early evening he is usually in a quiet, companionable mood. He may crouch or lie on the bed, stretch out in the living room on a bare part of the floor or on a window ledge, panting like a dog if warm, or in winter



AT HOME in his Minneapolis apartment, Geronimo finds human ways a constant source of delight. Always curious, he learns rapidly and betrays not the slightest indication of "going wild." Lacking natural prey, he has devised substitutes which he captures during elaborate games of his own invention. Once he carried the game too far and devoured a tennis ball and parts of a rubber toy. These were removed by surgery. It was his only illness. Otherwise, civilization agrees with him perfectly

PARLOR MANNERS: Geronimo has the run of the house except for certain pieces of furniture. At three and a half months *(above)* he has apparently treed some luckless "quarry"

EXPERIENCED TRAVELER: *(left and below)* Geronimo is quite at home in Pullman coaches. He thoroughly enjoys snoozing in upper berths and finds as much fun in the metal washbasin as in any wilderness pool



(Right) GERONIMO disproves the superstition that wild animals will not look humans in the eye. He follows conversations by watching each speaker intently

THOUGH his diet is largely raw beef, Geronimo tries everything. Celery affects him like catnip, and he loves flowers, especially chrysanthemums. His loyalty to his owners is comparable to a dog's. If you have the patience to train a lynx and romp with him, your reward will be the affection of an intelligent, perennial child

[illegible] our shoulders and presenting muzzle and then tail in [illegible]

[illegible] Geronimo. This is the time when he likes to turn on [illegible] arched back, ruff out and whiskers forward, getting ready to attack. He tolerates being held by all four feet and swung in circles to be landed on his side on [illegible]

He may assert his independence by remaining in the living room after we have declared it bedtime. He [illegible] tiently waits for us to come after him, so that he can jump out and surprise us. If we don't come, sociability finally overtakes him and he creeps gradually nearer and nearer, till he gives in and enters his den. But perhaps what he likes best of an evening is to have us read aloud beside him while he lies in his house. This is true family life in his eyes.

Unless he is exceptionally drowsy, Geronimo will answer when spoken to after the lights are out with a cheerful warble. During most of the year he then keeps quiet until the alarm clock goes off again in the morning. Sometimes in the spring, when it gets light early and the birds begin to sing, he is bored and cries. We then throw a little water on him which keeps him busy washing himself till he falls asleep again.

Language

It is customary for Geronimo to press his forehead against familiar playthings and people, particularly an outstretched hand. If we introduce him to new friends, he presents first his muzzle and then his tail. He also declines an object courteously with his forehead. After he has eaten his dinner he usually "gives thanks" in a loud, triumphant whinny. This seems wholly an expression of satisfaction.

Geronimo "warbles" by rapidly opening and shutting his mouth and nodding his head up and down. He once did it thirteen times in one outburst. It can be as shrill as a whinny, soft and sweet, or round and full. All these inflections are employed in talking to us, varying with the situation, and he evidently believes himself to be understood in some detail. Indeed this is so, for his needs are fairly limited, and one can guess what he wants. A prompt response on our part to his legitimate desires has led to deeper understanding and greater use of language on his.

Geronimo purrs only under conditions of complete comfort, mental and physical, as when we are all tucked in bed after a hard day, or when he is lying drowsy in his den and we stroke him while he licks us. About the only other time he does it is when we have just returned to him after an absence of several hours.

[illegible] to be fierce as in some of his games, and when objecting to rough handling, when it may sound quite perfunctory and simply means, "No, please don't. You might hurt me." During the games or in extreme nervousness, the ruff stands out, the whiskers come forward, the back is arched. The gait becomes stilted, and the growls alternate with blowing through the nose and hissing, with the tongue showing between the front teeth. The hair along the middle of the back may rise. The growl may be as loud and deep as that of a large dog, but rises to a shrill whine. It should also be noted that the nose drips under emotional stress.

Crying (the nearest thing to a "meow") simply means boredom, the wish to be let out of the den, or general dissatisfaction. It is the only unpleasant sound he makes, and should usually be ignored. It often culminates in real deep-throated cuss words and a snort of exasperation.

On the few occasions when he has been visited by friends during our absence, Geronimo has talked to them in a cordial manner.

No doubt the action of the tail should be included in a description of language. Though only about six inches long, it is strong and seldom quiet, waving gently from side to side when he is gay, and switching rapidly during his rougher games. When he is watching events from a window unobserved, only the tip moves, but that very fast and nervously. When he watches our box turtles through the crack under a door it is like a house cat watching a mousehole, and the tail switches audibly.

Geronimo's affection for us is comparable to that of a dog. He does not mind showing his feelings, and it might be noted that he is obviously worried when one submerges all but one's face in the bathtub. Knowing what baths are, the cat seems afraid that one might go too far with them. He is also disturbed if one of us pretends to spank the other, who then cries. He stalks about in great excitement and a state of indecision about his own duty. When we pretend to make up he rushes forward warbling and tries to be included in the embrace. I have little doubt that he would help us out if we were attacked by strangers.

Geronimo the traveler

Geronimo has proved to be a pretty good traveler and has taken several long train journeys, partly in baggage cars and partly in a Pullman compartment with us. We carry him in a traveling case designed for a terrier. Although he likes to sit on the seats and look directly out of the windows, he may perch instead on one of the tiny shelves and watch the landscape go by in a mirror. At night he spends a good deal of time ascending and descending from one berth to the other. In fact, I do not believe I was dreaming the time I saw him jump with a sort of corkscrew movement from the upper to the lower direct.

We have been surprised and gratified at the matter-of-fact way in which a lynx is welcomed at hotels both large and small. Ours has been offered a place in the kennels of one large hotel; and in some, registration cards are kept for pets. When released in our room he explores every inch of it. At the least alarm he goes under the bed, the nearest thing to his own den he can find.

It takes a good deal of exercise to satisfy so great an athlete. A year ago he weighed 29 pounds, is 31 inches long (six being tail), and stands about eighteen inches high. Like a cat he jumps to our shoulders and even to the tops of doors without effort, and the latter is his favorite place for trimming his claws. At an early age he could be observed calculating distances and planning new and daring jumps in the apartment. If he dreams it is probably of such feats. In his flying leaps from the dining room to the bed or vice versa (nine feet), he likes to dive through the small openings in the footboard. He walks on the rim of the bathtub and can fish objects from the water with his forepaws while keeping his hind feet on the edge of the tub. He "banks" with all four feet high against our bodies, sometimes when going at full speeed from one place to another round a curve.

In Arizona when people speak of the "lynx" they evidently refer to the brightly marked subspecies to which Geronimo belongs; while "bobcat" means a desert subspecies of a general yellowish shade with subdued pattern. Thus the people from whom we bought Geronimo said, "You'll be able to raise it because it's a lynx, not a bobcat." There was disagreement about which is larger, probably because more than two subspecies are involved.

At one of the California lion farms we saw a nest of baby wildcats which were snarling and spitting whenever anyone looked at them. The keepers remarked that here was one animal they found impossible to tame. It may well be that two or three would be much harder to train than one brought up alone in close association with human beings. Certainly we have known of more than one case like our own. There are few who would believe it possible, however, and the first question asked used to be, "When will he go wild?" Since he has become full-grown this question has changed to, "You keep his claws trimmed of course," which we don't.

Another idea is that the sight or smell of blood is what "brings out that wild instinct." "You don't ever give him raw meat, do you?" When we say that raw beef is his principal diet, people look as if they have suspected it all along and now they know we are lying.

The belief that you can't punish a member of the cat family is also firmly fixed in everybody's mind. We found this to be untrue. Not only does Geronimo take in good part a spanking with a newspaper or the flat of the hand, but he often gives away the fact that he has been up to mischief by protesting his innocence in melting tones and then lying down on his side in the spanking position.

One frequently hears the statement that a wild animal cannot meet the eye of a human being. Our cat looks into our eyes to corroborate what we are telling him, and also follows conversations closely by watching the face of one speaker after another.

Altogether the presence of a well-trained lynx in the home adds a great deal to the spice and pleasure of life. If you have the time and patience, if you always remember to be firm but just, if you have a simple household where there are not too many people to be disturbed, if you are willing to spend some time every day kicking balls or crawling on your knees looking for them under the furniture, and especially if you are able to do these things year after year, then perhaps you are the person to educate a house-lynx. It sounds like a recipe for bringing up a child, doesn't it? Well, that is what your reward will be: the trust and affection of an intelligent, perennial child.

THE MASSACRE OF ST. VALENTINE'S DAY

[illegible]

[illegible] means. It was carried on, along with many other similar practices that had long since wandered from their original function. But Choice came to the fore, and it was the smart thing to send [illegible] Valentine's Day to the maiden of your heart. [illegible] of the Chance element gave the valentine the force of an actual proposal and, no doubt, many troths were plighted on this historic day.

At first the verses were genuine, if crude: "Oh my love, my dear love pretty! How I love you!" garnished with a dripping red heart spitted on an arrow. But before long, valentine verses were being turned out professionally with the "heart-dart" rhyme scheme rivaling the "June-moon" of our own Tin Pan Alley. In 1797 there appeared a book called the *Young Man's Valentine Writer* and a few years later, *Cabinet of Love* or *Cupid's Repository of Choice Valentines*. Included were verses suitable for different tradesmen. For literary quality, compare a quotation from one of these:

> [illegible]
> [illegible]
> [illegible]
> [illegible]
>
> [illegible]
> [illegible]
> [illegible] Valentine
> Like sole and upper leather.

with the latest valentine message supplied by Western Union:

> Dan Cupid's dart has scored a hit,
> My wounded heart is off a bit,
> But I'll gladly bear the pain
> [illegible]
> [illegible] Valentine'

People frequently lament this industrialization of sentiment and regard it as a repellent by-product of compulsory literacy. But though our tastes might "improve" with time, we shall probably retain the commercialized sentiment until that doubtful millennium when everyone sketches and versifies with equal skill.

Perhaps even more cogent than the [illegible] nineteenth century, reductions in mailing costs kept pace with new developments of the entire field of communication, and soon postmen were weighted down under a deluge of flowery verses and paper frills. But the boom was not for long, since the valentine subsided when the Christmas card came into favor in the middle of the century.* The latter rapidly outstripped its sentimental forerunner and continues the overwhelming favorite to this day, doubtless because Christmas occupies a much higher rank in our scheme of loyalties and because the details of its celebration are universally understood.

The valentines, meanwhile, again shot off at a tangent. Someone invented "comic valentines," verbal brickbats anonymously delivered, whose manufacture [illegible] industry. Six million were sold in one year in the United States. Here indeed was the crowning perversion. It caused the time-honored festival to be turned over to a pack of scuttling, doorbell-ringing urchins. There follows an example of the sort of thing they left thrust in the mail slot, evidently a lineal, but malevolent, descendant of the "trade valentine" of former years.

Plumber

> Of all the scamps you are the worst,
>   You ugly looking snipe!
> You swindle us with defective work,
>   Wretched traps and rotten pipe.
> And you're not alone a swindler
>   But a murderer as well
> For you poison many with sewer gas
>   Your thievish gains to swell.

[illegible]

[illegible]
Irwin
[illegible]

Oddly enough, children have played a considerable part in undermining this feast day, which once clearly belonged to the age of puberty. Through their agency, Valentine's Day picked up a peculiar, mercenary quality which it shares with Halloween, Thanksgiving, Christmas, and even Good Friday.

In line with the latter is the strange note that children once used to beg a special type of pastry known as Valentine's buns, which apparently resembled hot cross buns. Also it was an ancient custom at Beaumanor in Leicestershire that all children who put in an appearance on Valentine's Day should receive a penny, while a house in Essex raised the ante by offering sixpence to every child who showed up at 8:00 a.m. The prevalence of this feast day begging can be seen in a number of verses which ring curiously to the modern ear:

> Good morrow, Valentine.
> Change your luck and I'll change mine.
> We are raggety, you are fine
> [illegible] us a valentine

and

> Knock the kittle agin the pan,
> Gie us a penny if 'e can
> We be ragged and you be fine,
> Plaze gie us a Valentine
> Up wi' the kittle and down wi' the spout,
> Gie us a penny and we'll gie out.

---

*In William S. Walsh's [illegible] *Popular Customs*, occurs the following interesting statement: [illegible] of the nineteenth century. These were [illegible] rounded with those hideous and elaborate pen-flourishes forming birds, scrolls, etc., to which writing-masters still have an unnatural and inexplicable attachment, and sometimes headed with copperplate engravings, plain or colored. They were used by school-boys at the approach of the holidays for carefully written letters exploiting the progress they had made in composition and chirography. . . . Charity boys were large purchasers of these pieces, and at Christmas time used to take them around their parish to show and at the same time solicit a trifle."

This is certainly a far cry from the amorous festival of Pan and Juno Februata, and the answer seems to be that St. Valentine's Day, once removed from its Lupercalian beginnings, became a footloose vagrant, fixed on the calendar but otherwise a heavy borrower from other appointed days in all seasons among the peoples of western Europe. The churchyard divinations smack of Halloween.* The begging may originally have been taken from some religious ceremony of alms-giving. And with the arrival of comic valentines, the day has taken on some aspects of April Fool.

Nevertheless, it has been kicked about for so long now that we would hate to see it go. Charles Lamb has written a moving apology for the best that is in the festival, and we could do no better than to close on his note of buoyant optimism:

"However we may observe the day of St. Valentine, its character has been stamped by the generations who entered into its celebration sincerely, joyously, spontaneously; and however indifferent we may be, we cannot escape that influence which is the inheritance of years gone by, when swains became gallants, and the humblest maiden was made happy with a devoted valentine for at least a day."

---

*See "Halloween: Ancient Festival of the Dead," by D. R. Barton, NATURAL HISTORY, October, 1938, p. 224.

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BIRDS OF THE GREY WIND

– by Edward Allworthy Armstrong

Oxford, $3.[illegible]

LOVE of birds has prompted many to [illegible] others to express themselves in prose. [illegible] deftly reach the place of literature. Here, however, is [illegible] equipped to describe both the birds and the country in which he has found them. The youthful memories of an Irishman, living now in England, betray a longing for the land of his birth and its birds which his inspired pen permits him to share with his readers.

Birds of the Grey Wind therefore is both ornithology and literature. We may refer to it for knowledge of the birds, chiefly coastal, of County Antrim, or we may read it for a poet's appreciation of the land and its legends. In either case we will discover that both the birds and their country have found a faithful and gifted historian. Hear him describe Strangford Lough as a "luminous water-colour of heroic dimensions, a saga in light; land and water merely sidelines and incidental handmaids to a greater glory." "Ireland's charm," he adds, "whether in winter or summer, on moorland or shore, consists in no small degree in the spaciousness of her skies, her lovely clouds, opalescent distances, and the soft, clear radiance of every remote view."

The illustrations, from photographs by the author and others, were selected to avoid subjects suggesting with "monotonous reiteration that birds spend all their time brooding or dangling food into their chicks' mouths." Hence we have a series of unusual, attractive and informing pictures. The dipper and the roosting tree-creeper, the young cuckoo evicting a hedge-sparrow's egg, the chough and its young deserve particular mention, and one rarely sees a more truly pictorial bird photograph than that of the sparrow hawk.

Frank M. Chapman.

CALIFORNIA AND THE WEST

by Charis and Edward Weston

Duell, Sloan and Pearce, $3.[illegible]

HERE is a [illegible] book illustrated by [illegible] photographs taken by Edward Weston, with a text as good as the pictures, written by his wife. The project, which consumed two years, was carried out with the aid of a Guggenheim fellowship. The photographs were not made with a [illegible] camera [illegible] on a tripod [illegible] with the K2 [illegible] filters.

As indicated by the title, the country covered is mainly California from south to north, with forays into Oregon, Washington, Nevada, Arizona and New Mexico. The subjects photographed include breath-taking landscapes, desert scenes, ocean views, mountains, abandoned homes, ghost towns, drift stumps, storm clouds, farms, orchards, and vineyards—in short, an excellent cross section of the rich and varied West.

It is no disparagement to say that the photographs are not quite what most of us would have expected. There are no pictures of the Grand Canyon of the Colorado or of the California Bigtree. The point of view of the photographer is indicated by a remark he made when prospecting for pictures in Red Rock Canyon with its eroded spires, buttresses and natural cloisters: "What can I do with it? It's all done. Photographing this stuff would be like copying a painting. Anyhow, it's too damned pretty."

Mrs. Weston not only acted as chauffeur, but she also kept a careful diary from which she has drawn an informal and most readable book to go with these striking photographs.

Clyde Fisher.

GEOGRAPHY IN HUMAN DESTINY

by Roderick Peattie

George W. Stewart, $3.00

GEOGRAPHY, says Doctor Peattie, is the reciprocal relationship between physical environment and life. Before he is through his book, however, even this fairly broad definition is considerably expanded. But no one should complain of the wide cast of Doctor Peattie's net, for he catches in it a fascinating array of information.

The trends of history and the broad characteristics of human cultures are what especially attract Doctor Peattie. His effort to explain these phenomena on a geographic basis furnishes the thesis of this book. There was a time not long ago, when environmental determinism in human affairs held a pre-eminent place in speculative writing. That position was lost by claims too great to be satisfactorily supported. As a result, environmentalism suffered a serious decline as a determinant in human history. But the truths of environmentalism, although forgotten or obscured for a time, cannot be disowned. They serve Doctor Peattie well in this revival of the environmentalistic philosophy.

With a cautiously selected battery of examples of the geographic influence on the course of human history, Doctor Peattie advances an effective argument for his contention. His erudition is nicely concealed by a restraint in the use of evidence and by a pleasant unacademic style. I heartily recommend *Geography in Human Destiny*.

H. E. S.

THE MAMMALS OF CHINA AND MONGOLIA (Parts I & II)

by Glover M. Allen

Edited by Walter Granger

Each Part, $10

Published by the American Museum of Natural History

IN many respects there is no section of the earth's surface as interesting geographically, geologically, and biologically, as Asia. It is a vast continental mass that was the birthplace of many lines of animals as well as of some phases of human culture. It is cut by numerous large rivers, between which are some of the world's loftiest mountain ranges, many of which, with their particular floras and faunas, are completely segregated from each other by low country, in some places of subtropical nature. Hence the problems in the distribution and interrelationships of the mammals of China are of extreme intricacy. Difficulties incident to sketchy methods of travel over great distances amid political conditions frequently unstable have contributed to the fact that as a whole the fauna of China has been incompletely known and poorly understood.

As a result of Roy Chapman Andrews' plans, so comprehensively carried out by the Asiatic Expeditions of the American Museum of Natural History, there has been accumulated the world's finest collection of Chinese mammals which, by an arrangement with the Museum of Comparative Zoology of Harvard, has been studied and here reported on by Glover M. Allen. This appears in two large volumes of 1350 pages, listing the 514 kinds of mammals recognized as occurring in China. There are 20 plates of photographs and 75 text figures, mostly distributional sketch maps. They are extremely helpful but show few details and localities, so that the reader finds himself wishing that even a small-scale map of the whole of China had been included. Only one who has worked over scattered descriptions of mammals from a strange country can appreciate the keys, not only of races but of genera, and the characterizations of the higher groups that accompany the present report. Besides original citation, there is for each kind of mammal a careful description with measurements, and as much about occurrence and habits as is known. The first volume included a historical and general faunal consideration and an exhaustive bibliography. This concerned insectivores, bats, primates, carnivores, cetaceans, pangolins, and hares and their allies (in all, 258 kinds). This volume appeared in 1938. The Second Part, just off the press, treats of the rodents, ungulates, and the sea cow. It is probably this volume that will appeal most to the average reader. Of recent years there has been a great interest in the game animals of Asia, which has resulted in a number of hunting expeditions with trained collectors among their personnel, and these have accumulated notes and material that have enabled Allen to clear up many of the moot points concerning the game mammals of China. Thus did Brooke Dolan rediscover MacNeill's deer on the Tibetan border, unrecorded since its original discovery in 1909.

Not the least of the difficulties in a study of Asiatic mammals is the fact that many of the types are scattered and inaccessible, and the early, and some later, descriptions are vague. Hence it is fortunate that the present report was prepared by one of the world's soundest and most scholarly mammalogists. His invaluable discussions of relationships in the present volumes are the result of many years of study and he shows a masterly grasp of the literature. But whereas weeks of work at the British Museum were deemed necessary, the author failed to examine many of the type and other critical specimens of Chinese mammals in the National Museum at Washington, at times accepting or rejecting the validity of the races under question on evidence that was largely circumstantial.

Regardless of the condition in which China may finally emerge from her present tribulations, it seems certain that the dispersal of the Chinese fighting forces, with their firearms, will result in the destruction at a greatly augmented rate of all the large animal species. Henceforth the collecting of these forms will doubtless present greater difficulties, and the world is indebted to the Asiatic Expeditions of the American Museum for accomplishing its work before it was too late.

A. B. H.

PRINCIPLES OF ANIMAL BIOLOGY

- - - - - - - - -by Lancelot Hogben

Norton, $3.75

THIS book "was not intended to supplant but rather to supplement the work in the laboratory, for which many excellent guides or manuals are available." Although the beginning student will find herein a fresh and stimulating approach to general biology it is unfortunate that the author has omitted reference to many important recent advances in various fields—a lack which is emphasized by the fact that this, the second edition, postdates the first by ten years. The choice of references is a difficult task, and must, in many instances, rest upon personal preference. It seems unfortunate, however, that a discussion of parthenogenesis should be limited to mention of Loeb's work (1899) with the eggs of the sea urchin. A brief account of contemporary findings with mammalian material (Pincus *et al*) would give a broader and more accurate rendering of the general topic. If the synthesis of adrenalin is worth mention it is difficult to understand why there is no reference to the fractionation, identification, and synthesis of numerous products of the hypophysis, thyroid, ovary, and testis. A discussion of sex reversal which is limited to recounting the effects of ovariotomy in the hen and parasitization in the male crab seems regrettably incomplete in the light of the impressive evidence for sex reversal subsequent to gonad transplantation or hormone administration.

Supplemented with comprehensive lectures and extensive laboratory work this book would serve admirably as a beginning text in biology. It cannot be recommended for the reader who lacks a reasonably thorough knowledge of comparative anatomy and general physiology.

F. A. BEACH.

AMERICAN SONGBIRDS

- - - - - - - By Maitland A. Edey

Random House, $1.00

THE distinctive characteristic of this attractive-looking book is its low price. In what other publication can you buy for $1.00, 30 of Louis Fuertes' colored plates illustrating 105 species of our land birds? It is true that these plates originally appeared in Eaton's ***Birds of New York*** and that they have also been used by the University Society (1917) and Doubleday, Doran & Co. (1936). But they cannot have too wide a circulation and we hope will brighten the text of many subsequent volumes. While the prints show the demands that have been made upon the plates, they are nevertheless acceptable reproductions of the originals.

The text prepared to accompany the illustrations gives a brief description of the markings, manner of occurrence and habits of each species.

F. M. C.

TRAIL OF AN ARTIST-NATURALIST

- - - - by Ernest Thompson Seton

Scribner, $3.75

EXCEPTIONALLY talented, constructive, ambitious, with the courage of strong convictions and the power to express them, Ernest Seton has set his life on a stage where, with the unstinted force of a highly dramatic nature, he has played a leading rôle.

Only his contemporaries realize the extent of our indebtedness to him as naturalist, artist, scribe, preacher, and sympathetic biographer of wildlife. To itemize the bill would take more than all the space allowed for this review. But the amount of the total may be indicated by the statement that, in the reviewer's opinion, Seton has done more to arouse an interest in nature than any other writer of his time.

Evidence supporting this belief may be found in this record of his life. If its author seems a prejudiced witness (autobiographers are often lenient) the doubter should seek the testimony of those whose life span covers the periods, before as well as after, the publication in 1898, of ***Wild Animals I Have Known.*** This was followed by other books addressed to nature lovers, young and old. In all, over two and a half million copies of Seton's works have been issued. His audience has been immeasurably increased by thousands of lectures, woodcraft councils, and by his activities as one of the originators of the Boy Scout movement.

Seton's success produced many followers who, lacking his standards, often wrote with disregard of truth. But all alike were condemned as "nature fakers" by conservative naturalists whose protests were voiced by John Burroughs in ***The Atlantic*** for March, 1904. Urged to defend himself Seton said, "My only reply will be in my works." And in due time they took form in four quarto volumes on the lives of North American mammals. Accepted as authoritative by his colleagues and awarded the Elliot Medal by the National Academy of Sciences, they form alike his vindication and crowning contribution to knowledge.

Of recent years Seton, now fourscore, in his New Mexican home, has devoted himself to a study of the North American Indian, greatest of our native mammals.

FRANK M. CHAPMAN.

THE CHORTI INDIANS OF GUATEMALA

- - - - - - - by Charles Wisdom

University of Chicago Press, $4.50

THIS book gives a full account of a typical Indian community in Guatemala. The style is compact and factual, presenting a surprising amount of information in the 490 pages of text. Every important phase of community life is well covered. What the reader will perceive is an ethnic group of Indian people under the nominal control of the Guatemala national government, loosely integrated into the framework of the Catholic church, taking no important part in the political affairs of the nation, except when a few men are temporarily drafted into public service for a brief interval or when they are confined in prison. From careful observation the author concludes that 70% of the diet is maize. Yet many other kinds of vegetable food are produced or gathered, the variety being impressive. As may be anticipated, animal food is but a small part of the community diet. Occasionally a deer is killed. Pigs, turkeys and chickens are raised, the pigs chiefly for sale in the towns, fowls for ritualistic purposes rather than for food. The meager monetary income of the family is chiefly from the sale of pigs.

The Indians are not grouped into social classes, but they themselves constitute the lowest social class in the nation; the mixed-blood Indian of the towns ranks next. Since Indians form a large part of the populations in Latin-American countries, this book, with its careful description of a typical Indian community, should give the reader a better comprehension of life in these countries.

CLARK WISSLER.

SCIENCE IN PROGRESS

Second Series

Edited by George A. Baitsell

Yale University Press, $[illegible]

THIS second volume of essays [illegible] the National [illegible] Sigma Xi [illegible] each [illegible] The material is presented clearly and interestingly and is profusely illustrated. [illegible] may be considered a modern encyclopedia of science so far as these ten branches represent samples of the whole field.

One leading geomorphologist, Professor Douglas Johnson of Columbia University, gives us the latest and best discussion of the mysterious craters of the Carolina coast, treating it as a study in methods of research. Dr. Carl D. Anderson, Nobel Prize Winner in Physics, of the California Institute of Technology contributes a comprehensive and yet popular chapter on cosmic rays and new elementary particles of matter.

The subjects of the other essays with their authors follow: "The Experimental Alteration of Heredity," by L. J. Stadler; "The Regulation of Plant Growth," by F. W. Went; "Experimental Studies on the Functions of the Frontal Lobes in Monkeys, Chimpanzees and Man," by J. F. Fulton; "How the Earth Shows Its Age," by Alfred C. Lane; "The Expanding Universe," by H. P. Robertson; "The Motions of Ions and Proteins in Electric Fields," by Duncan A. MacInnes; "The Ultracentrifuge," by J. B. Beams; and "Recent Advances in Aeronautics," by J. C. Hunsaker. An adequate bibliography for each chapter is given in the back of the book, together with an extensive index.

The Society of the Sigma Xi, which is devoted to the promotion of research in science, has made available here a most readable account of the methods and results of research in these representative fields.

CLYDE FISHER

THE HISTORY OF MUSICAL INSTRUMENTS

by Curt Sachs

Norton, $5.00

IT is remarkable that there exists in English [illegible] work on musical instruments so comprehensive as Professor Sachs's [illegible] volume. No [illegible] of the subject is left unexplored and each is investigated with the caution of sound scholarship.

"Man alone is gifted with conscious rhythm." From this distinctive feature of human behavior have come both the dance and the invention of a staggering variety of music-makers. The history of their development proceeds through the devices of the lowest cultures up to the most complex instruments of the modern orchestra. Every considerable epoch in man's experience receives mention. A large number of halftones, line drawings and diagrams enhance the value of this prodigious reference [illegible]

ANIMALS IN ACTION

by Gayle Pickwell

Whittlesey House, $4.00

THIS [illegible] of a series of large natural history books, beautifully and [illegible] illustrated. The pictures are instructive and tell many stories far better than words can. The accompanying text is a splendid introduction to animal biology, succinctly describing the main problems of life. There are chapters on the shelters constructed and utilized, the ways of reproduction from amoeba to mammal, growth and development (including metamorphosis), ways of feeding and obtaining oxygen, defense, locomotion, evolution and the relationships between animals. Lastly there is a section telling how to become acquainted with animals, and some personal experiences of the author.

It would be pleasant to give the text unqualified approval, but there are several inexplicable misstatements: five-toed deer, digitigrade squirrels. These are minor, but definite, detractions from an otherwise splendid book.

JOHN F. [illegible]

MODERN WILDERNESS

by William Arthur Babson

Doubleday, Doran, $3.00

WITHIN the network of broad highways crisscrossing the state of New Jersey there remain many areas still relatively wild. To one of these, scarcely 25 miles from lower Manhattan, Mr. Babson calls particular attention. Along the Passaic River near its junction with the Whippany lies a swampy wilderness where wood ducks and black ducks nest, and one may find the larger owls, hawks, mink, skunk, and occasional beaver and deer. In youth the author studied its many birds, and recently made it his hunting ground during four profitable years.

He gives us a collection of essays rather than a systematic account of all its wild inhabitants. These tell of his excursions by canoe or on foot to nests of the larger birds, of hatching wood duck eggs under a hen and rearing the ducklings on a lawn, of bringing up young crows as pets, catching huge snapping turtles, photographing a killdeer, and watching the "sky-dance" of the woodcock. Other adventures include one with a skunk, and there are talks with Jean, the trapper. Mr. Babson shares the belief of Doctor Chapman, who has written him an appreciative foreword, that turkey vultures are aided by smell in their search for food. He understands the sportsman's attitude, and discusses its paradoxical views on killing and protecting.

In the final chapter he laments the invasion of electric power lines, new bridges, polluted waters, and the deepening of the river for flood control. More automobiles race along the roads, more billboards rise, and the radio tells of war and bombing. But at the very end, Mr. Babson still finds beauty and serenity in his New Jersey wilderness.

JAMES P. CHAPIN

PLANT GALLS AND GALL MAKERS

by Ephraim Porter Felt

Comstock, $[illegible]

THE abundance of drawings and photographs in this book is of great help in identifying the 2000 plant galls found in North America. For ease of determination the galls occurring on a certain plant are grouped together and the types of galls are then separated by descriptive keys. The Introduction gives much general information on galls and gall insects and tells us of the extraordinary life histories of some of the latter. Naturalists, specialists, and teachers of biology and nature study will find that this reference book is both interesting and invaluable.

J. W. THOMSON, JR.

MANUAL OF CULTIVATED TREES AND SHRUBS

by Alfred Rehder

Macmillan, $10.50

IMMEDIATELY upon its first appearance in 1927 this manual became an essential volume in the horticulturist's library. This second edition, revised and enlarged, is even more essential to anyone working with woody plants. In concise form, with keys to families, genera, and species, it describes all of the trees and shrubs known to be in cultivation north of a line running approximately from North Carolina, through Texas and New Mexico, to northern California. Many native as well as exotic species are described. The zones within which the various woody plants are winter hardy are indicated by reference to a frontispiece map of the United States and Canada. Other useful facts included in the descriptions of the species are references to illustrations of the plants and their parts, mention of the habits of the plants in cultivation, of the place in which the plants are native, and the dates of introduction or first-known cultivation.

Over 2550 species are included in the second edition, about 200 more than in the earlier edition. The number of hybrids, varieties, and species but briefly described has grown proportionately. An indication of the scope of the work is the index, which covers over 14,300 names. It is remarkable, however, to find some of the smaller plants such as pipsissewa, spotted wintergreen, trailing arbutus, wintergreen, partridge berry, and snowberry included in a volume on trees and shrubs.

Changes in the International Rules of Botanical Nomenclature required some changes in the names of some of the plants and the new edition has been brought up to date in this respect. Fortunately, Professor Rehder has, with but few exceptions, adopted a conservative treatment of the genera and species of woody plants. On the eve of his retirement as Curator of the Herbarium at the Arnold Arboretum he has given us a most thorough and indispensable manual.

J. W. THOMSON, JR.

LETTERS

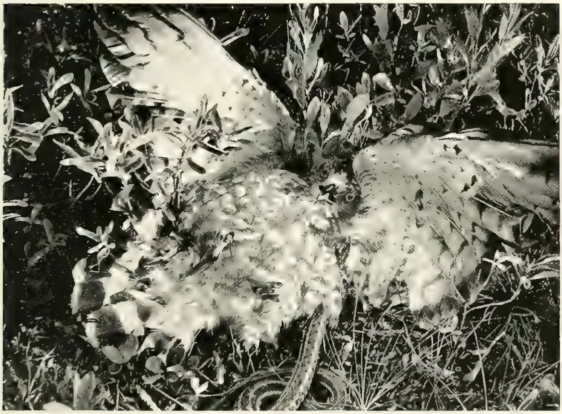
Continued from page 66

Sirs:

Late one afternoon in August, I was driving along one of the typical sandy roads in the heart of the pine barrens of southern New Jersey when I noticed a commotion in a thicket of sheep laurel *(Kalmia angustifolia)*. I ran to the spot and saw the unusual spectacle of a young broad-winged hawk which had tried to capture a snake and had as a result itself been captured. The 35-inch long garter snake had sunk its teeth into the under part of the wing of the hawk, preventing the bird from flying. The accompanying photograph was taken while the two struggled. (I felt a little sorry for the hawk—its pride must have been terribly hurt.) A moment later, I lifted the snake by the tail, and it released its hold, allowing the bird to fly wearily away through the tall pines.

John Gill.

Haddonfield, N. J.



Photograph by John Gill From a Kodachrome original.

THE CAPTURER IS CAPTURED. This young hawk was "grounded" by the grip of the snake in its wing

Sirs:

I wish to express my appreciation of, and interest in, the article, "Talk-without-Talk," by Robert Hofsinde. The pictures are fascinating and are of great educational value. I hope we are going to have more articles and pictures by the same author.

Greta Bodelle.

New York, N. Y.

* * *

Sirs:

I was very much interested in your article in the January issue on Indian sign language, "Talk-without-Talk," as I have been working for some time with the Flathead Indians on the sign language, too.

In comparing the signs Mr. Hofsinde used with my own records, I find a few differences as follows, probably the result of local differences in "dialect," just as we observe them in spoken language:

(1) Here the sign for "tree" is made by raising the hands upward to indicate growing toward the sky—without the "trembling like leaves."

(2) Woman: the two hands together at the center part of the hair are brought down on both sides, indicating that the hair is parted in the middle (as opposed to the way the men wear a lock tied at the top and a part on the side)—instead of the combing motion. Among the Flatheads and Blackfeet, only the squaws part their hair in the middle.

(3) White man: although the sign was in this case the same, my model, Louie Nine Pipes, and other Flatheads, explained that it was because the first white men had their hair cut across the forehead. They use another sign for "hat," indicating the brim with one hand on each side of the head.

(4) Buffalo: the forefingers indicate the curved horns of the buffalo.

(5) Hungry: Louie Nine Pipes points to his stomach with both hands, but does not use the "motion like sawing body in two with edge of the hand," as described by Mr. Hofsinde.

(6) Man: the Flatheads use the upright forefinger only for a young man, as it means a man who walks erect or a "youth." They never use it, as Mr. Hofsinde did, together with the sign for "old."

I have been working on a sign language dictionary, because I feel, as Mr. Harrington does, that it is too vital a part of Indian culture to be allowed to die, and because I, too, have found that even now only the older members of the tribe can speak it fluently.

Jane Greenough.

Couer d'Alene, Idaho

* * *

Sirs:

As a reader of your excellent magazine, I wish to comment favorably on the sign language article in your January issue. It is splendid! I hope the author is considering a book on the entire subject.

Caroline Brown.

New York, N. Y.

Continued on next page

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Sirs:

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[illegible]

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[illegible]

[illegible]

• • •

Sirs:

[illegible] Natural History Magazine. Many people see my copy, in[illegible] me regularly. . .

[illegible]

[illegible]

• • •

Sirs:

[illegible]

[illegible]

• • •

Sirs:

We [illegible] Natural History [illegible] magazines which [illegible]

[illegible]

[illegible]

• • •

Sirs:

[illegible] lar in our home. . . . Many thanks for such [illegible] and absorbing manner of presentation.

[illegible] W. Zimmerman, M. D.

[illegible], Kansas

• • •

Sirs:

. . . Thank you for the pleasure which has come to our entire family through this excellent magazine.

Mrs. Wm. S. [illegible]

Arlington, Va.

• • •

Sirs:

[illegible] month Natural History [illegible] interesting articles that the magazine is loaned to several families on the campus. It is a fine magazine for [illegible]

[illegible]

Lapwai, Idaho

• • •

Sirs:

We appreciate Natural History Magazine in my family very greatly, and particularly so because we believe it has [illegible] year-old grandson, who is one of your subscribers. . . .

(Signed)

Milwaukee, Wis.

• • •

Sirs:

The Christmas present that gave me the biggest thrill of pleasure this season was the Certificate of Associate Membership in the American Museum of Natural History [illegible] Natural History.

Through the kindness of a friend, I had access to copies of Natural History for the last three years, and in no other periodical I ever read have I found the contents from cover to cover so interesting and worthwhile. To welcome a copy of my very own each month through 1941 will be a joy. The December number with its beautiful Night Blooming Cereus cover and intriguing table of contents has already arrived.

Natural history has long been my major delight as a student. . . . Its revelations of perennial beauty, wonder, orderliness, if widely enough known, might become a precious antidote against despair, against cowardice, an inspiration to press on daringly, persistently, toward a better-yet-to-be, through this Dance Macabre transition from an old to a new era in world history.

May the American Museum of Natural History and its fine publications long continue their good work.

(Miss) M. E. McGuire.

University of California
Berkeley, Calif.

• • •

Sirs:

In the November issue of your magazine, there appeared an editorial entitled "The Museum and World Changes" in which there were several statements which might easily be misunderstood and which, if not understood correctly, might be considered misleading, if not untrue. I have reference to the statements, ". . . when the principle of evolution became generally accepted," and ". . . because it [evolution] enjoys as nearly universal belief as any philosophy."

I am aware of the work that the Museum has done and the decided opinions it has in regard to evolution. However, I think it is not in accord with facts to say that evolution is generally accepted as a principle, or worse still, to represent it as something universally accepted. I can appreciate your point of view but I feel it is a little misleading to the uninformed reader to put the case as strongly as you have.

I have read and enjoyed this magazine for some time and have enthusiastically recommended it to a number of youngsters. I hope I shall not find it necessary to curtail my enthusiasm or qualify my endorsement in the future.

Willard I. Keane, D.D.S.

New York, N. Y.

• • •

Sirs:

One of my most pleasant surprises in receiving my copy of Natural History Magazine each month comes from reading your Letters Department, and it gives me the greatest satisfaction to know that, with very few exceptions, each and every one who writes to you expresses my personal feelings in their high praise of the Magazine of the American Museum of Natural History.

I feel sure that all our Natural History readers, including myself, believe in the Creator's evolutionary laws, both as applied to the plant and animal life of the world and even to the earth changes which have taken place preparatory to the existence of organic life on this planet.

There has always been a conflict between religion and science on this issue of the origin of life, and particularly of man on this earth; but we are convinced by irrefutable scientific facts that God created all things in a slow and orderly series of evolutionary changes, which have resulted in our perfected forms of plant and animal life today. The American Museum's complete exhibit of the evolution of the horse from Eocene time to the present is produced from proven remains found in the rock pages of the earth's history. . . .

Words fail me to describe adequately the beauty and profound interest of the [illegible] which the December 1940 copy of Natural History contains. Each and every one of the subjects treated in this issue is right in line with my courses of study, and I am deeply grateful to you for your timely sources of information.

Could you furnish me with two extra copies of the double-page graph of the "World's Highest Waterfalls" covering pages 272 and 273? If so, kindly advise me as to the cost.

The article entitled, "The Tar Pit Tiger," by Edwin H. Colbert is most fascinating and comes close to my heart because I live only 140 miles from the famous La Brea Tar Pits in a suburb of Los Angeles and have visited them several times.

E. B. Powers

San Diego, Calif.

Natural History regrets that no extra copies of the waterfall chart referred to are available.—Ed.

APPOINTMENTS

Dr. Robert Cushman Murphy, of the Scientific Staff of the American Museum of Natural History, has been elected President of the Long Island Biological Association.

Dr. George C. Vaillant, likewise of the Museum, has been elected Vice-President of the Section of Anthropology in the American Association for the Advancement of Sciences for 1941.

Dr. Harry L. Shapiro, Associate Curator of Physical Anthropology at the American Museum, was made Associate Editor of the *American Anthropologist;* and Miss Bella Weitzner, also of the Department of Anthropology, was appointed Treasurer of the American Anthropological Association at the same annual meeting in Philadelphia, on December 29, 1940.

NOTICE

Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

March

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Natural History

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Above illustration painted by F. L. Jaques, from Bird Group of Hudson Bay Region in the American Museum of Natural History

A LETTER FROM AN ENGLISH CORRESPONDENT

The secretary of an English naturalists' association tells how biological work behind the scenes helps the Army and the home front

YOU'VE probably read all the news about the war in your newspapers and listened to all the official communiques from Europe on your short-wave radio, and so I don't intend to deal with the war as such. I have just sat down at the end of a day's exacting work, and while we prepare to meet our 255th air raid I think I ought to tell you, an American audience, how I, an English biologist and secretary of a naturalists' association in the second most heavily bombed part of our country, have worked behind the scenes to help Britain's war effort outside the fighting line. Of course I won't say anything that might release useful information to an enemy agent, even if it passes the censor; but the wartime work of a naturalist is not generally associated with secrets and new campaigns.

When this war shadowed the horizon in 1939 I expected my time to be fully devoted to writing, lecturing, and instructing farmers and gardeners about growing more foodstuffs, because this island cannot support itself like France and America. But I've had very little of that sort of demand upon my time. We found that the farmers and amateur gardeners didn't want telling how to plant and grow vegetables in order to stock our larders: success was to be gauged by the number of ploughs and spades and men to work them, and land to plough. I thought I would spend a lot of time telling farmers how to get rid of their crop pests; but they say they are the same pests they had before, and they've been told often enough how to deal with them.

No, the job of a biologist or a naturalist in wartime is often as surprising and unexpected as the varied conditions affecting the fighting forces. I suppose my closest association with the war itself has been in consultation for Air Raids Precautions. You might wonder what on earth a biologist has to do with protecting people from blast, shrapnel, bombs, and splinters. Most people think A. R. P. is merely engaging builders to construct shelters for the people, medical men to care for the injured, and firemen to put out the fire-bombs. So did I in 1938.

In 1939 one of our national A. R. P. bodies was paying me to settle a number of biological problems as they arose. One of these concerned fungi. Many of our hastily-made shelters were safeguarded with sandbags or earth bags stacked against the walls. It wasn't long after the autumn rains that those bags of Hessian cloth began to rot, and suddenly a whole wall of sandbags might collapse, and anybody nearby might be injured. What was the cause of this rapid decay of sandbags in the rain, and how could it be prevented? It was all the work of a fungus or mold. Most of the bags were filled with earth, because people in many towns had better access to their gardens than to the seashore. And a wall of such bags developed a humid, poorly ventilated atmosphere, encouraging growth of the minute, dust-like spores of the fungus. Nearly all this damage was done by one mushroom—*Peziza repanda,* which normally grows on rotten tree trunks lying on the ground in our beech woods. Now it has become a common "resident" in nearly all our cities.

With the winter the shelters became the resort of hibernating insects, and in the community shelters in big towns there was a serious problem of fleas, lice, flies, and other insect carriers of disease. I was able to be useful here because most of our authorities had whitewashed the interiors of the big, public shelters and I had noticed that white is a color which attracts flies and gnats, whereas pale lemon-yellow is a warning color that actually repels them. Formalin sprays were able to keep check on the fleas where they occurred in some of the towns, and the bedbug was checked with fumigants.

Botany, too, has played its part in our A. R. P. work. Much of the cotton you send us from America is wanted for munitions and for surgical dressings for the Army. During the campaigns in the last war there was a shortage of cotton wool and similar surgical material in England, but as there were no great casualties from air raids at home it was not serious. This time, however, there must always be a good reserve of surgical dressing for first aid during air raids. Therefore, I got to work on another emergency substitute, which was used in the field in the last war and in the Spanish war. This is dried and sterilized sphagnum moss from our moors and hillsides. This moss has, in point of fact, considerable advantages over cotton wool as an absorbent in surgical dressings, for it has very large cells normally used to store moisture against drought. It proves not only more absorbent than cotton wool bandages but more retentive, thus requiring changing less often.

The food industry, which is so vital to an importing country like ours, has brought me a lot of work identifying and controlling the molds and insects attacking stored foods in ships, warehouses, and flour mills. A great number of the insects have to be fought with low temperature sterilization because the usual fumigants and sprays would contaminate the foodstuffs. But the difficulty is that different temperatures are needed to kill or check the activity not only of different insects but of the same insect in different stages of development, as egg, larva and adult. Many of these temperatures are still unknown. Molds are generally checked by temperature control, and although they receive less publicity, they are just as destructive to industry as insects. When great stores of foods are accumulated, new insect invaders are apt to appear, because insects often alter their diet and change from useful into very destructive agents.

Continued on page 119

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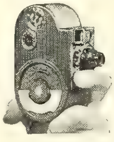

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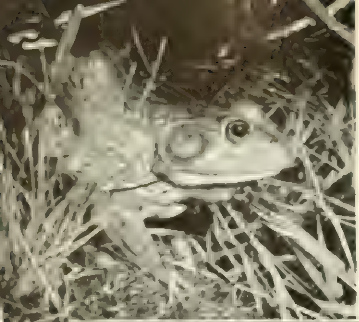
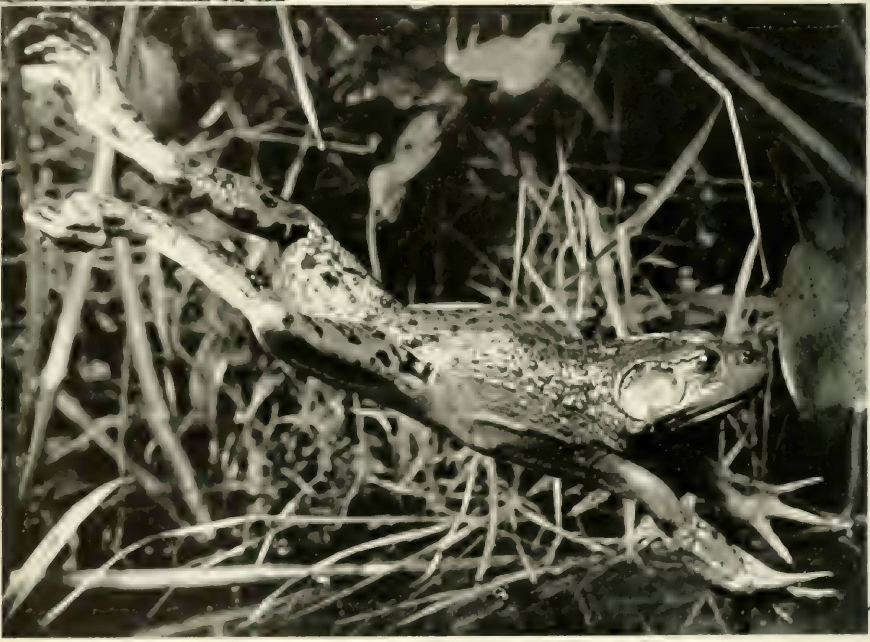


THE CAMERA IS QUICKER THAN THE EYE

By HENRY B. KANE

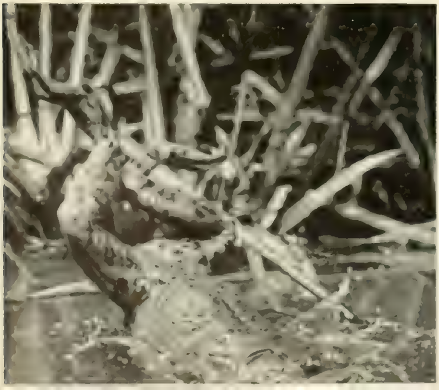
A remarkable series of photographs of one of nature's diving champions, taken at an exposure of approximately 1/50,000 of a second with the high speed photographic lights developed by Dr. Harold E. Edgerton

1 The bullfrog is always ready to leap . . .

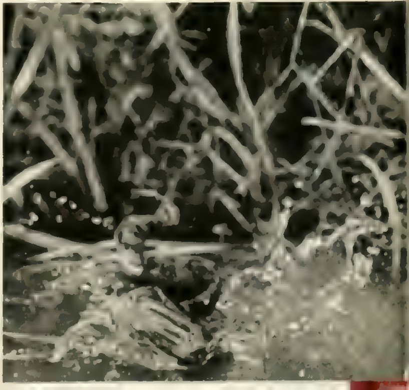


2 . . . through the air with the greatest of ease . . .

3 . . . into the water . . .



4 . . . and out of sight . . .



A LETTER FROM AN ENGLISH CORRESPONDENT

Continued from page 117

The naturalist was also called upon to recommend to the food manufacturers new sources of raw material for food when the war on the continent of Europe cut off many of our old food imports. These new sources varied from new methods of canning wild rabbit meats with onion and other palatable ingredients, to herbs, salads and fruits from the wild, and the recommendation of gull and other common birds' eggs suitable for cooking purposes when there was such a great egg shortage after our poultry flocks suffered havoc in the hard winter of early 1940.

The drug industry made a special appeal to the British Empire Naturalists' Association to marshal its forces of field botanists. This was to help overcome the shortage of drugs due to the sudden cessation of normal imports from the continent. High prices were offered for certain wild plants from which drugs can be manufactured, for instance, foxglove, which is a source of digitalis, henbane, which gives hyoscyamine, deadly nightshade, which gives atropine, and so on. Before this I had induced our botanists in the Merseyside Naturalists' Association, of which I am Secretary, to draw up a list of all the useful herbs growing in the district, whose seeds could yield products for the drug industry. There were over a hundred of them.

Investigating current conditions in glasshouses and conservatories at a special meeting, we found it was possible to cultivate under glass the plant sources of such drugs as cocaine, strychnine, camphor, ipecacuanha, etc. We also sent some advice on the cultivation of the wild herbs on a large scale in gardens and farms at the urgent requests of the pharmaceutical people, who knew the plants were wanted in greater supplies than the wild could offer but who did not understand their individual wants in the way of soil and so forth.

The mining industry is another important branch of the home front where valuable service has been rendered through natural history investigations, chiefly through the identification and control of fungi or molds which attack pit props and hasten their destruction. There is a great shortage of timber, due to enemy occupation of the great exporting countries in Scandinavia and the lack of American shipping facilities to export from the great Pacific Coast forests, so that anything which can be done to conserve in the consumption of our own pine trees is very useful. I was interested to find a dozen different species of fungi attacking the pit props in the mines, some of the most destructive providing their own moisture and thus attacking dry districts at the coal face. But props could be sterilized against them, and some timbers like larch are much more resistant than others, like spruce. There was also work to be done on the contamination of pit props by pine beetles carrying the spores of dry rot from one part of the mine to another, or destructive insects attacking the pit props.

Animal fodder was largely imported before the war, but because ships are now engaged in carrying foodstuffs and ammunition, hundreds of pit ponies have had to receive their share of scientific attention. The colliery owners in South Wales and Scotland have been given advice on how to balance the diet of their four-footed helpers in order to maintain their strength and health upon various substitutes making up their chaff and provender.

The record frost early in 1940 killed thousands of useful insect-eating thrushes and other birds, so that I was giving special lectures on how the population of these useful birds could be increased again by providing more suitable nesting haunts and feeding grounds. The ploughing up of thousands of acres of old grassland, golf courses, playing fields and parks for more corn made plagues of wireworms, which had to be tackled by heavy rolling and deep cultivation.

These are only a few of the activities for which you will have space. I could name many, from the problem of barnacles, which can take 20% off the speed of a 5000-horsepower cargo vessel (a serious handicap in these times of increased schedules), to the development of effective camouflage, largely copied after the methods used by various animals, for the protection of motorcars, garages, and so forth. In all these things, the naturalist has assisted unexpectedly in the wartime program.

In addition to all this there has been a great deal of spare-time voluntary work, which I think is almost as important as the more technical efforts. Helping nature study amongst our school évacués moved from the towns to the country for the first time in their lives, gave the youngsters happier memories than bombs to take back to town. We started a nature club at one village, and a village museum in another. We keep going the full activities of lectures, rambles, filmshows, and journals amongst our amateur natural history societies, universities, and museums, even in the bombed cities like London, Liverpool, and elsewhere.

In many towns our lectures continue during air raids, except for those members who are air raid wardens, nurses, or Home Guard men, and they slip out to duty and return with the "all clear"—if it comes before morning! And by carrying on our organized nature study in the midst of the battle we believe, from the results, that such hobbies provide a welcome and valuable rest and change, however brief, from the duties and dangers of the times. It is most encouraging to find people attending a field meeting after a night on duty, or to help a refugee naturalist from Holland, France, or Czechoslovakia continue his studies, confident that when this horrible business of war is over we can again devote full time to nature in the out-of-doors and set to work conserving the wildlife and its sanctuaries which have been destroyed by this total war.

ERIC HARDY.
Liverpool, England

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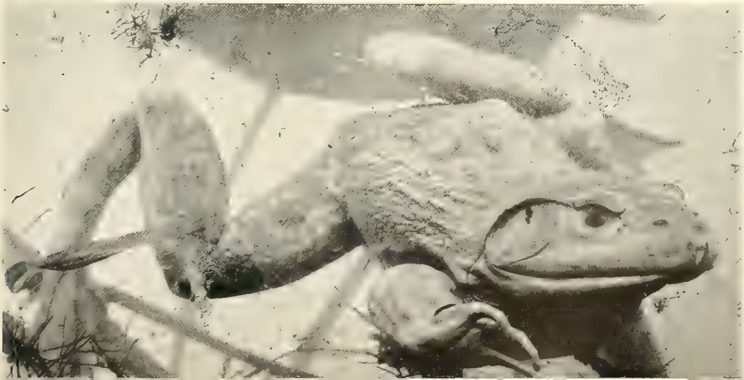
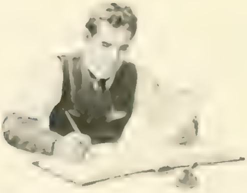
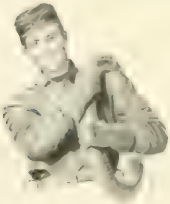
5 . . . where he is so expert at the frog stroke



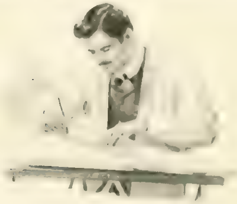
EACH CAN SAY



"I WAS A CLERK"



"I WAS A LINEMAN"



"I WAS A DRAFTSMAN"

THIRTY-SEVEN years ago, in 1904, the president of the American Telephone and Telegraph Company went to work as a clerk in one of the Bell System companies.

About that time, the 18 men who are now the presidents of the Bell telephone companies were starting their careers. For, like the head of the System, they have worked many years in the business — an average of 38 years each. Each of them can say: "I was a clerk," "I was a lineman," "I was a draftsman"— and so on.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, SC.D., Director

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MOJAVE IN

A momentary transformation of the hard dry face of the desert into a sea of bloom—a living carpet of silver and gold, where bees are drunk with perfume and hummingbirds are enraptured by the miracle of spring

ALL lands that [illegible] the season we call spring have a spring flora and whereas it [illegible] moment [illegible] of the year. I have seen some of the best on earth: the Mediterranean with its hyacinths, narcissus and crocus, the Appalachian honeyed with azalea and trillium. And the California coastal zone, where sky-blue lupine and golden poppies cover the hills and go dancing to the edge of the cliffs in sheets of color. I suppose I [illegible] you do not know the glory of the world until you have seen the Cape flora of Africa burst forth in the antipodean spring that begins in September, bringing calla lilies, garden geraniums, gladiolus and endless exquisites of the iris family into wild unlikely being. Writes another plantsman, a world wanderer, "In variety and beauty, the flowers of the Albany district of West Australia,

---

This article is a chapter from Donald Culross Peattie's forthcoming book, *The Road of a Naturalist*, published by Houghton Mifflin.

Red Rock Canyon, Mojave Desert, southern California

[illegible]

FLOWER

By DONALD CULROSS PEATTIE

from August to November, surpassed anything the writer has ever seen." There full-blown orchid splendors spring from the parched soil, and insectivorous pitcher plants and great sundews spangle the sward.

That's all as may be, and I wouldn't, from anything I had seen upon the desert in many springs, have dared to hope for better. But not even on the Alps, in full summer, had I ever beheld so dancing a carpet as on that memorable April morning when I stepped out into the Mojave in bloom. Not every spring does the stone roll back like this, but only when the rain and the snows and the sun combine fortuitously to decree it. I had not seen the miracle before, roadrunner though I had been for years, crisscrossing the southwestern wastes.

Now, as anyone will cry out involuntarily at an unexpected sharp pain, so there was no stopping the laughter that rose in the throat at the sight. Not just the first time, and not just on my lips. Everyone at the ranch, each time he stepped out again into the dazzling profusion of color and dancing shapes, laughed again, a pure enchanted laugh.

The desert flora at all ordinary times consists of tough resinous shrubs, knee-high to waist-high, a few head-tall. It is grandly, confidently monotonous, made up of certain hardy species which do not hesitate to range, without apology, unvaried over an area as great as the two Virginias plus the two Carolinas. That is the norm, the always present uncompromising reality, in season or out.

Nature's tapestry

But this other visitation, this momentary translation of the hard dry face of the desert, was all herbaceous, made of tiny annuals. The sea of bloom was only ankle-deep; many species were not an inch tall, but with flowers two inches across. In this fashion the beautiful little desert stars, like English daisies, and desert-gold, tiny-tim, humble gilia with its petals the color of moonlight on frost made a dense undercarpet that it was piteous to tread upon.

Above this close undermat danced a second tier of flowers, goldenglow and white tidytips and desert dandelions with heads of canary yellow. And, pervading the whole desert with fragrance, rose the pink sand verbena, of the four-o'clock family. There was a lupine that ran everywhere, of a deep royal purple. There were the scabiosa sages, salvias really, that the Spanish settlers called *chia,* whose brilliant blue, two-lipped flowers leap out of a tiny spiny sphere of angry purple bracts. There were desert mallows, with their crumpled dusty leaves and chalices of fiery flowers varying from vivid apricot to deep grenadine.

But commonest of all, most constantly in motion on their hair-fine stems, most innocently frail, were the blue gilias. Some were clear white, some lilac, some true blue, some with yellow eyes, some tall, some dwarf, looking like many species, actually only one variable kind, *Gilia davyi.* When the wind blew and these children of the desert danced, their fragrance was blown quite away; when the sun baked perfume from the sand verbena, the gilias' odor was smothered. But when I brought them inside the dark coolness of the great adobe room, I became aware of a tender perfume stealing into my thoughts, getting into my dreams at night. Every day, every hour, you saw the gilias, but you never got used to the sheer improbability that anything so dainty could be put forth by the Mojave. Indestructible, thorny, bare, the creosote bush and salt bush, the burro brush and rabbit brush are the natural sons of the desert, warrior sons, like Homeric soldiers naked but for spear and shield, thorns and bitterness. But just as a savage man might beget gentle daughters too, so the Mojave sends forth blue gilias, once in many years a million of them, like this.

Above the two tiers of flowers there rose spindling examples of a third. Here and there, for instance, a slim wand of lilac larkspur. Or thistle sage, kingly tufts of cottony silver thick with long mauve salvia flowers, the longer for their orange anthers. And an aster with lavender heads in bold clumps of 20 blooms and more.

In all, those April days yielded to my vasculum some 75 species. Large as this number sounds, it is not a greater variety than would be found at a corresponding stage of seasonal development anywhere else; what brought delight was the sheer abundance of the carpet, the feeling that we were actually besieged by an army of little flowers. The bees were drunk with them; they came in thousands from only the Mojave knew where. I saw the hummingbirds flash by in such a state of excitement that they looked as if they had been shot sideways out of a cannon with a twisted bore. They seemed unable to settle their scattered brains on anything; they went so fast I couldn't follow them with my glasses to identify which of California's many kinds of hummers they were. We used to wonder, at the ranch, how far this flood of rare flowering washed across the desert floor. You couldn't tell; you only knew it went on to the rim of the horizon. And you knew it was brief. It must be loved while you had it, like the song of the thrush in the southern states. Something that each morning you dread to find gone at last, whelmed by the advance of summer heat.

Waves of the desert

Resting from the sweat and blindness of collecting in full sunlight at noon, I would lie on my back in the adobe room, on the cool of the tiles, and let the flowers dance before my eyes, and in my head the map of the desert unroll. Steep pitching floors, dry lake beds glistening with soda, alkaline sinks below sea level where, in Death Valley and beside the Salton, another flora sprang—queer iodine bushes, bloated and jointed greasewood, ugly arrowweed, rusty samphire. Desert ranges far to the east and north, a hundred and three hundred miles away across [illegible] peaks of the Panamints and Inyo and Providence Ranges [illegible] high in their stone [illegible] snows under their stunted pines. Already the low desert, down by the Mexican border, would be out of flower, [illegible] dropped from the desert [illegible] still.

Spring that is more than spring

And the biologic meaning of this year's rare visitation of flowers was borne in upon me. Desert plants do not follow what we consider a normal cycle—green in summer, and dying back to some perennial root in winter. For when it is calendar summer here it is biologic winter: the leaves drop and everything dies or wears the look of death. It is also, biologically, winter in autumn and winter, when snow lies on the desert. But spring is not only spring but summer and autumn in swift succession. And of all desert plants the best equipped to deal with this climatic extravagance are my little annuals, my fragile exquisites so prodigal of their scant waters. Swiftly indeed do they wilt. They not only wilt, they die, completely, the entire crop—only to survive as seeds. As seeds, a year later or, if conditions oblige, ten years later, they will sprout again, and in from two to six weeks rush to full flower, become pollinated, set seed, distribute seed, and die again. Such is the life of an annual, and of all forms of life-history the annual is the best for desert life.

For, like the seventeen-year cicada which is a grub all those years underground and enjoys but a few weeks of aerial life as a winged, singing, mating adult, the swift vanishing spring desert flora passes the greater part of its time as a dormant seed. Only irregularly and most briefly does it escape as a flower, before the continuous stream of life is caught inside a seed again, indefinitely to wait. So the champion desert plant is not the tough creosote, the malicious cholla, not the Joshua tree or the sage, but seed as tiny as gilia's. For a seed is not just part of a plant: detached, it is a complete plant, with a plantlet folded inside, a supply of food, an infinitesimal of moisture. Boxed in its shell, it defies drought, heat, cold, poisonous alkaline soils. Only water has the password to open its prison.

Now I began to notice seeds everywhere. The deliberate big harvester ants, who can both bite and sting so fiercely, were bearing away seeds of all sorts of plants, as fast as they fell, in industrious braided lines. I saw chaff outside the untidy nests of pack rats, and I presume that all of the desert's tremendous rodent population of gophers and kangaroo rats, [illegible] and field mice, are in part dependent on seeds. As seeds are the secret and triumphant desert flora, so they are the hidden larder, the basic food supply. Birds, too, devour them.

The heat, and more still the light, were often insupportable as the days crawled lizardlike across the desert. I wore a great peaked sombrero of lightest straw, and smoked glasses, sandals and white ducks and a rag of shirt. And still I was often so giddy I felt I must drop flat or die. I saw black and red before my eyes, and I measured the distance to the roof of the adobe cottage with the eye of one who has to swim back to shore farther than he is sure he has the wind or muscle to make it. The snows on the San Gabriel Range looked mockingly cool and distant as the mountains of the moon. Finally I cowered in the cool shadow of the cedar roof, writing up notes, pressing specimens, reading; and only went out at dusk.

Some come with the stars

It was then that I discovered that the desert dandelions and Mojave asters and many other flowers close up at night. And another flora, nocturnal, steals into bloom. All day long one lax and weedy plant looked dead, its flowers withered. But at night this wild four-o'clock secretly opened its rose-pink calyces and emitted a faint odor. Where I had tramped the burning blossoming swells and hollows at four and seen nothing of it, a flower called evening-snow suddenly appeared at dusk. Leaf and stem are mere sand-colored threads; flowers are twirled up by day into a pointed bud absolutely invisible in the glare. But fifteen minutes after twilight's fall, millions of them open, with a soundless silken uncurling of their petals, and lo, they are white gilias, the color of starshine. As they expand, a delicate fragrance takes the air.

The West is the kingdom of evening primroses, as it is of the four-o'clock family. Though I knew many species of evening primrose, still I was unprepared for the great dune primrose I found in the desert dusks. Its crepuscular flowers are large as those of a wild rose when they open, but insubstantial as spider floss, great mothlike petals languidly opening as if still oppressed with the long siesta of the day. They are white, but as soon as you pick them they turn pink, and in ten minutes they are faded and cannot be revived. They seem to have just the requisite turgor in their gleaming cells to sustain life only if they are not sun-smitten or touched by human hands. They are so secret that they cannot survive the appreciation of a fingertip, and they hold their sweet breath until the approach of darkness.

I left the ranch in mid-April, wanting not to see this rainbow fade. Early in May a friend wrote:

"Come back; there is another flora on the way." It was easy to leave my desk at that. Gone was the first candor of the early flowers, and in their place had come a gaudier, coarser, stronger flora, corresponding, I suppose, to those of eastern summers. Yellow buckwheat was everywhere, and another flower, called "alkali goldfields," had replaced the coreopsis. A sort of branching dandelion took over from the desert dandelions; the strange rock pink was in flower, and the desert trumpet, too, and it was the season now of *el barbasco,* the fish-poison spurge, and *Stillingia* spurge with angry red spikes, that gushes a spurt of milky juice upon the hands in revenge for being picked. The beaver-tail cactus was glowing with its deep rose cups. Where the sunlight blazed the fiercest, where the hard sands reflected its intolerable glare, there burnt up from the ground an almost stemless cup of fiery orange. It is something to look a desert mariposa in the eye. You find mariposas all over the West, changing height, changing shape and color, as you trace them from the mountains of Colorado, over the Utah deserts, up and over the high Sierra, down into the great Central Valley, climbing the coast ranges and descending till they dance on the brink of the sea cliffs of the Pacific. They change names, too—fairy lanterns, Mormon lilies, cat's ears, *Calochortus.* They are lilac and pink and white; they are like white tulips, delicately penciled and blotched; they are like dainty fritillaries, nodding cup half closed. Nothing you ever saw of them prepares you for the desert's one species, for that intense cup of flame. And within the orange petals stand clear the six chocolate-purple anthers and the elegant long erect ovary, neatly three-angled and clean straw color.

Prickly and inhospitable

The ground was prickly now with inhospitable kinds of gilia—prickly gilia and calico flower. Underfoot were the little spiny-herb, all ridges and prickles and points, symmetrical on a plan of three; and a relative that looked as if it had been cut out of tarnishing metal by Euclid. At the center of its saucer of bracts you find what looks like a clutch of tiny seeds, only to discover that they are really the larvae of a beautiful little blue butterfly.

In the innocent phase of spring there had bloomed a sprawling *Astragalus,* very like a lupine, but straggling, crazy, dusty, with a sickly pink bloom—locoweed of the cowboys. Out of flower now, its great inflated pods that popped when you touched them were bloated and blotched and scrawled with an alphabet without meaning, in madders and purples and garnet lines. Loco, that drives the horses mad, that kills them with its deadly chemical selenium.

The paper-bag bush, too, was now in pod, just a few of its purple mint flowers left, where I had seen the hummingbirds at pollination. The hop-sage was turning red, as if with autumn tints; the color of the fruits upon the Mormon tea was trembling between rose purple and rose pink; bronze was overcasting the saltbush foliage, and out on the desert burned the last unholy glories of its ultimate flora—*Nicolletia,* with off-shade yellow pinks and mustardy green yellows and a skunky odor that simply would not wash off the fingers, also a brassy-colored *Dyssodia* with a name which means "ill-smell," thrice and four times deserved.

Smiling desolation of autumn

The desert at last had bloomed itself out; it had exhausted the gamut of beauty and, like a decadent, found beauty in the repulsive. By June, when it was true summer elsewhere, the Mojave was already far gone into the smiling desolation of its autumn. I would not even look at the brittle dusty yellow straws that were the stubble of the blue-eyed jillies. Life was going off the land; even the meager foliage of the shrubs was dropping, leaving naked thorns. The wasps were beginning to come out of the inflated stems of the desert trumpet, where their mother had laid them when that stem was succulent and bore flowers. It was so paper-thin and brittle now it broke at a touch; no sound was in its parched throat, no humming reveille in the trumpet. There was nothing anywhere, from the foot of the San Bernardinos to and beyond the Colorado River, except heat and wind, and sand upon the wind, and blinding light. The color had seeped out of the world—the laughing tints, the fiery hues that followed—, now there were the eternal desert ochers and grays, the washed-out rusts, the silvered stalks, the horizons dancing with heat waves. The desert had forgotten its one relenting tenderness; it had gone back to the vast inertia of being desert, as dryly and sternly itself as an old squaw. Even at 10,000 feet the snows on the San Gabriels were gone; they, too, were but winter's intercession. They were not eternal. The dew was gone from the mornings, each day a little less, until at last there was no sip for a linnet; the song of the orioles was silenced in the Joshua trees, the birds were hatched, the brown pouch hung empty. It was time for my departure; the desert itself seemed to be driving me out. I did not know when I should get back again. And when if ever I should see it bloom once more.

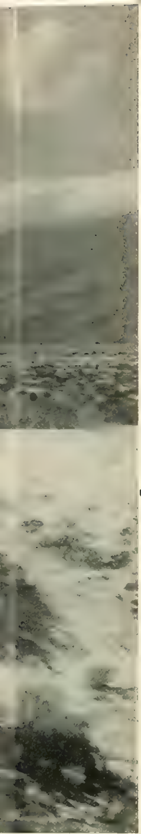
THE *FRIENDLY* DESERT

By Charles Alma Byers

Know your desert plants, and their beauty will open up a new world of enchantment

Deserts are commonly visualized as regions that are barren and worthless. Indeed the familiar dictionary definition is, "a region without vegetation." This idea, however, is more often mistaken than not, when applied to our American deserts. There are, of course, certain parts which are quite devoid of vegetation and where drifting sands rule supreme; but for the most part our desert lands support a much more abundant growth than is generally realized. And, contrary to common belief, the soil itself is often some of the most fertile in the world, so that when it can be given enough water it is surprisingly productive.

Early maps of North America labeled a vast area in the West, "The Great American Desert." The idea became established that something almost comparable to the Sahara existed out there; and only with the development of our modern railroads and highways has the Great American Desert shrunk to a few scattered areas. Private and governmental reclamation work is further constantly rescuing the desert from neglect; so that real desert conditions exist only in such spots as the Arizona Desert, Yuma Desert, Great Salt Lake Desert, Ralston Desert of



Nevada, Colorado Desert of California, Mojave, Death Valley, etc. And nearly all of these regions, even some of the most desolate parts of Death Valley, have their forests—of a kind.

The strange ways in which Mother Nature overcomes handicaps are nowhere better shown than in the vegetation of the desert and the semidesert. Here plant life must ever battle against endless drought, against scorching summer suns, harassing winds, and restless sands. There is little wonder that it is often fantastic in character and seemingly dwarfed in size. Yet it is also wonderfully beautiful.

FROM THE SPEEDING automobile or train, one does not realize that the desert lands of the United States contain an assortment of strange plants native to these American wastes and, in general, seen nowhere else on earth. Our native desert plants gave the Indians a wide list of useful products—fruit, beverages, medicines, clothing, and building materials—, as explained on the following pages. And the beauty of the whole is found on closer inspection to be built up of a number of fascinating parts, each displaying its characteristic form and colors.

The photograph at left shows the Colorado Desert of California. Here, as well as in southern Arizona, grows one of our strangest and showiest desert trees, the paloverde, illustrated below at close range.

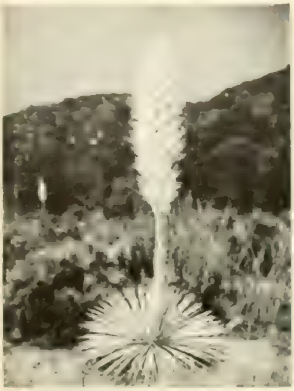
THE DESERT IS *BEAUTIFUL*

Viewed through air that is crystal-clear, landscape tints seen nowhere else lend a weird enchantment to this world of purple and gold. Yet the full beauty of the desert, overlooked by the hurried traveler, requires closer observation.

(Below) A GLORIOUS ARRAY of bright yellow bloom is put forth by the paloverde in March. The tree then becomes a study in brilliant gold, set off against the quiet green of its tiny oblong leaflets. The flowers are about the size of buttercups and produce a general effect resembling Scotch broom. The seeds, in pods two or three inches long, fall in July and are harvested by the Indians for food.

The name *paloverde* is Spanish for "green tree" or "green wood," for the bark of the entire tree, including even that of the main trunk, is light green and presents a strange appearance against the usual parched-brown background. The scientific name is *Cercidium torreyanum* (formerly *Parkinsonia torreyana).*

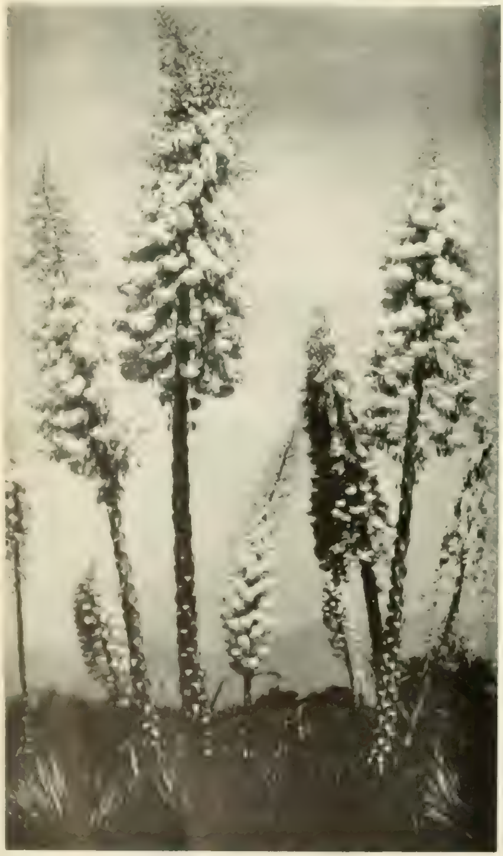
Photo by Putnam Studios

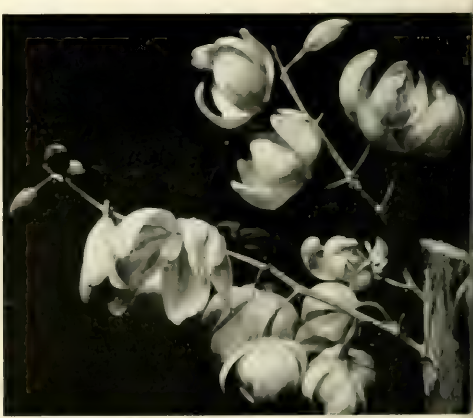


AT BLOOMING TIME the Spanish bayonet *(Yucca whipplei)* becomes a thing of glory and splendor. Previously only a sort of plant-life hedgehog, formidably armed and unapproachable, it now sends up from its center a tall "candle" of snowy-white blossoms—a shaft of light and marvelous beauty that can be seen and identified for miles around. This shaft is lifted to a height of ten or fifteen feet, and along one half to two-thirds of it is a gracefully bulging cluster of bloom. The base, a symmetrical mass of living bayonets, blue-green in color and each terminating in a hard point as sharp as a needle, remains on guard, but now the plant deserves its other name, the "Lord's Candle." Making its debut at the season when much of the other vegetation is turning brown in the summer heat, it presents a striking picture, spectacular and queenly by day, and specter-like in the light of the moon—a ghostly sentinel.

The flower stalk usually begins to grow about the last of April or the first of May. Leafless and blue-green, frequently with a reddish tinge, it rises rapidly, gradually swelling. The usual blooming season is in and around June.

The Spanish bayonet is one of the most interesting of several kinds of yucca native to North America. Its home, strictly speaking, is not the real desert, but the chaparral-covered semidesert of the Southwest. It is abundant in various sections in southern California and is found also in Mexico and Central America.





(Below) THE SMOKE TREE: a desert ghost which dons a regal cloak once a year. For many months the smoke tree *(Parosela spinosa)* is completely devoid of foliage and apparently lifeless. Then in late spring, as if awaking reluctantly from its slumber, it puts forth a thin sprinkling of small, narrow leaves, and suddenly, about the middle of June, it bursts into wondrous bloom. Its garb is no longer that of a wraith, but of a mantle of the most glorious ultramarine. The

(Below) THE "FLAME" of the Lord's Candle is made up of waxy, cream-tinted white flowers, sometimes with a tinge of purple, one or two inches in diameter.

Pollination of the blossom of this strange plant is seemingly left by nature almost entirely to a little white moth, whose larvae live on the seeds. This moth, first gathering pollen from several flowers, lays its eggs in the deep-set ovary and then pushes its assembled supply of pollen, rolled into a tiny ball, down into the blossom until it rests against the stigma. After blooming, the flower stalk turns grayish-white but often remains standing throughout the summer and fall—a sort of memorial to the yucca's one-time glory.

Photo by C. C. Pierce

"indigo bush" then soon sheds its foliage and again becomes a ghost.

The smoke tree is apparently the desert's very own. It loves the hot and sultry canyons but is occasionally found straggling forth even into the desert sands.

This might be called the "desert vamp" or "vampire"—"vamp" in the sense that it will lure man with false hopes by the appearance it gives of smoke lazily rising from a campfire; and "vampire" in the sense that it is likely to draw one's blood. Its spines, indeed, are so sharp and numerous that it is sometimes referred to as the "porcupine tree." Its slender, graceful limbs are also covered with a sort of fine, cottony fuzz.

A BANQUET IN THE DESERT

It would be a weird banquet, but if all the plant resources of the desert were gathered together, the diner would not go hungry nor lack variety. The meal could be eaten under candlelight produced by the candlewood tree. And the desert would also give soap to wash with, utensils for cooking, and even protection against its breezes, which can be surprisingly cold at night.

CANDLES. It is from the fantastic ocotillo, or candlewood *(Fouquieria splendens)*, whose branchless arms are rich in wax-like resin, that actual candles may be made. The wood readily burns with a steady blue flame, much like a wax paper.

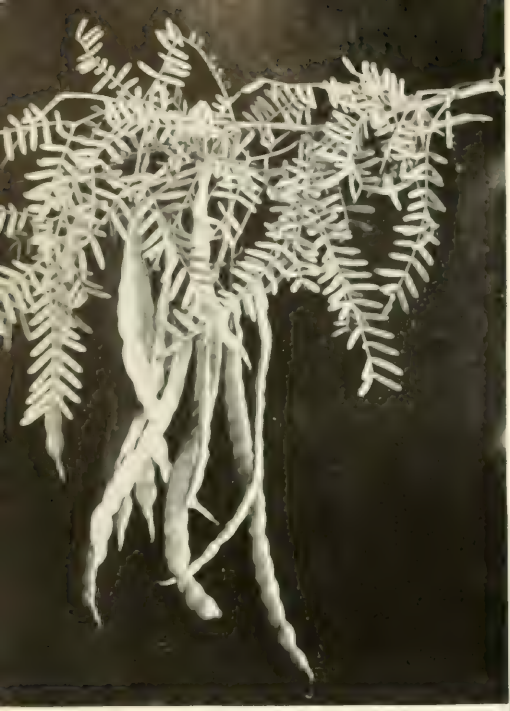
In spring each arm tips itself with a cluster of bright scarlet flowers, and the general effect is then like a bunch of long-staffed flaming torches. The ocotillo is very easily propogated by means of cuttings and is frequently used by Indians in making hedges and corral fences. The plant grows from fifteen to 20 feet high, and is native to sections of California, east to Texas and south to Mexico, thriving frequently on some of the most desolate wastes.

Photo by Putnam Studios

THIRST need have no terror for the desert traveler where the barrel cactus *(Ferocactus acanthodes)* grows. This "water barrel" of the desert has saved the life of many a thirsty wanderer. Approximately 90% of its total weight is water. When the top is cut off, the interior is found to be a firm, white, watery pulp, which, when crushed with a stone and then squeezed in the hands, yields its fluid. Indians made use of the juice as a drink and sometimes utilized the hollowed-out trunk as a cooking pot, boiling their foods in it by dropping in hot stones. White man has learned to make a very delicious candy from the pulp.

This cactus is called "bisnaga" or "visnaga." In early summer, it gives out a magnificent crown of several large greenish-yellow blossoms. The barrel cactus is rather easily toppled over, having little more than a long, slender taproot. To disturb this valuable plant unnecessarily is an offence against the laws of conservation.

Photo by Putnam Studios



ONE OF THE FRIENDLIEST growths of our arid regions is the mesquite. Beneath its spreading branches the desert traveler finds shade, and from its seed pods both man and beast may obtain wholesome food. And if your desert banquet is at Christmas time, you may decorate the table with mistletoe from its branches, which is seen growing on the mesquite below. This is the screw-bean mesquite *(Prosopis pubescens)* which bears clusters of screw-shaped bean pods. Our other well-known mesquite, the long-bean kind *(Prosopis juliflora var. glandulosa)*, bears the four- to eight-inch bean pods illustrated at left. Indians gathered the beans in large quantities and ground them into a meal from which they made a sort of mush. Even the pods were often prepared into a highly-prized black dye, and from a gum which a wound in the tree exudes they made both mucilage and medicine.

Unlike the barrel cactus, the mesquite has been known to send its roots in search of water to a depth of 60 feet. One or another kind of mesquite is found from Utah and Kansas to Mexico and from California to Texas.

(Right, below) THE GIANT CACTUS *(Carnegiea gigantea)*, or saguaro, bears fruit which the Indians prize as a delicacy. Indeed the Papagos make a great annual festival of its harvesting. The purplish-red fruit, maturing around the end of June, is roughly egg-shaped and contains, when ripe, a soft, red pulp with numerous small black seeds. Much of the fruit is eaten fresh, and some is utilized for making a rich wine. From most of the fruit, however, if the year's crop be large, they extract the juice and boil it down to a molasses-like syrup, which they store in earthen jars. They even preserve the seeds, which they grind and make into mush. The older portions of the trunk encase a number of long, slender poles, suggestive of bamboo fishing rods. These the Indians use as carrying poles and for framework of papoose cradles, and otherwise.

This cactus reaches a height of 40 or 50 feet and a possible thickness of nearly two feet. But a ten-year-old giant cactus is rarely taller than five inches. Some of the oldest ones are estimated to exceed 200 years in age and to weigh six or even eight tons.

Woodpeckers peck holes in the giant cactus and build their nests in them, and the cactus usually adjusts itself by lining these pockets with a special callous-like growth. However, the woodpeckers do not keep permanent ownership of all these holes, and many become occupied by the elf owl, said to be one of the smallest known species of owl. The giant cactus is found in Arizona (notably near Phoenix), in southeastern California, and in Sonora.

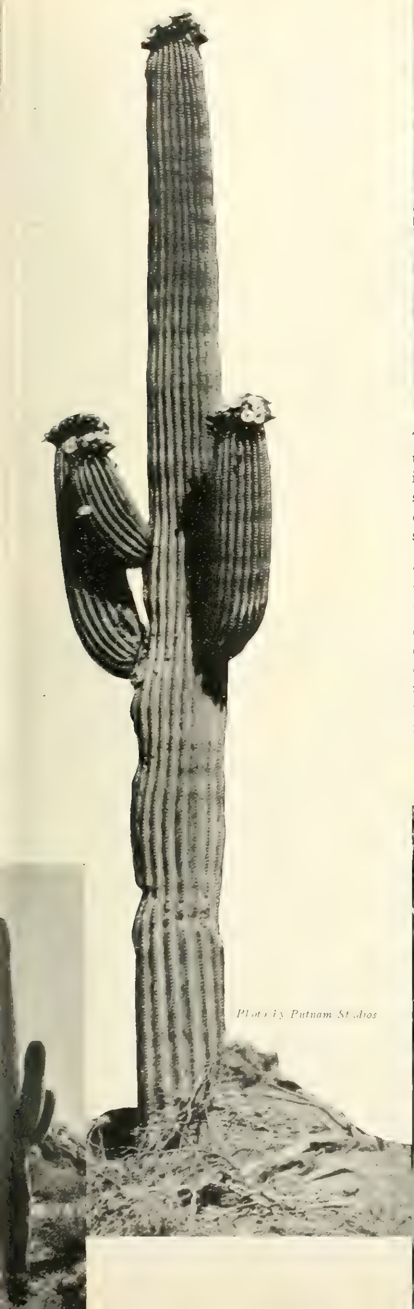
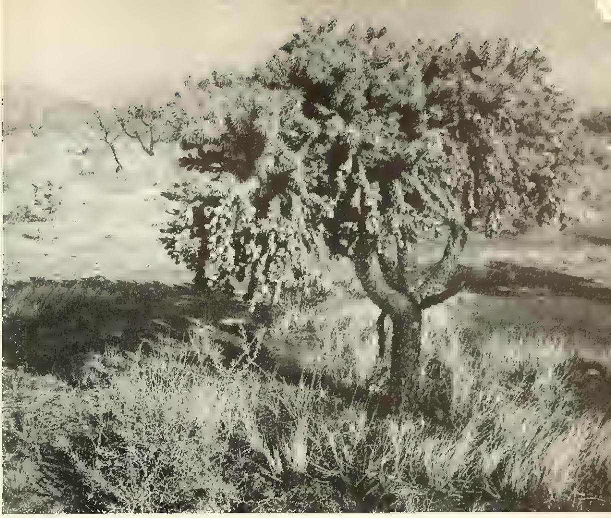


Photo by Putnam Studios



THOUGH the cholla cacti (pronounced "choy-a") are the most shunned, they too produce edible fruit. The fruiting of the *Opuntia fulgida,* above, is especially interesting. Its cup-shaped fruit is yellow, and one fruit seems to spring out of another in haphazard fashion, to hang in long chains. A close-up showing the less friendly features of this cactus is seen below. Its flowers are light rose color.

Most cacti classed as cholla are a bristling mass of needle-like spines. The spiny joints, somewhat suggestive of superferocious chestnut burrs, become detached by a mere touch—often from a gently stirring breeze. Indians and many Mexicans hold to the belief that they actually jump out at the passer-by, hence the nickname, "jumping cactus." To be sure, one can scarcely pass through a thicket of this cactus without finding one or more of the joints clinging to one's clothing. Pack rats frequently use the barbed joints to build a bulwark for guarding the entrance to their home, and how they succeed in carrying them borders on the incomprehensible.

Photos by C. C. Pierce

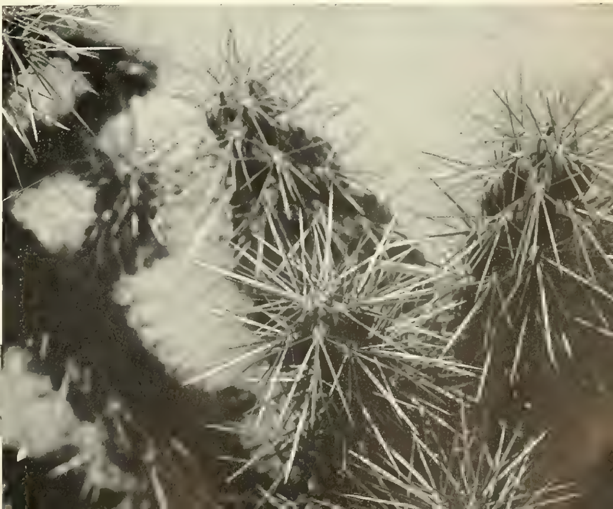


Photo by [illegible]

THOUGH FUZZY-LOOKING from a distance, one does not want to collide with *Opuntia bigelovii* after dark. Several species of cylindrical-stemmed opuntias received the name cholla. The most conspicuous are the ones shown above and on the preceding page, and two others: *Opuntia echinocarpa*, native to the Colorado Desert (yellowish flowers with red-tipped sepals), and *Opuntia acanthocarpa*, which thrives about Needles, Arizona (pale yellow blossoms with orange-yellow pistils).

Photo by [illegible]

FROM THE LEAVES and twigs of the creosote bush *(Larrea tridentata* var. *glutinosa),* at right, the Indians brewed a bitter tea (which they used as a sort of tonic) and made a liniment for healing wounds and for relieving rheumatism. Moreover, this bush yielded a yellowish-green dye, and its sap gave them a kind of cement employed in making bows and arrows.

The creosote bush inhabits the desert of almost the whole of the Southwest, from the low-lying foothills to the very heart of Death Valley. The gray stems are marked at all branch joints with blackish knots, producing a curious banded effect. At the blooming season the bush puts forth myriads of bright yellow flowers, nearly an inch across, with greenish-yellow sepals. Later come innumerable seed-balls—white, fuzzy, and silky. Being evergreen, the creosote bush lends a restful color to the desert throughout the year.

Photo by Charles Alma Byers

MOST FANTASTIC and individualistic of all our desert plant-life is probably the Joshua tree *(Yucca brevifolia),* shown at left and right. And, strange as it seems, it belongs to the lily family. From gawky youth to decrepit old age, it passes from one grotesque form to another. In the sapling stage it is a clumsy, shaggy shaft with a green topknot of dagger-pointed leaves. At a height of from eight to fifteen feet it puts forth its first branch, adding others thereafter until it becomes a full-fledged tree. When eventually old age creeps upon it, it begins to writhe and twist like a contortionist, until weary and weazened, its arms commence to sag. Then one day there comes a gust of wind, and the tree lies prostrate in the sand. A grove of Jushua trees seen at night under the light of a full moon is weird and uncanny—a garden of plant-life gargoyles in silhouette.

Yet the Joshua tree is not always a thing uncouth. In the late spring or early summer, the spiked tip of each contorted arm sends forth a ponderous cluster of pallid, greenish-white flowers, each nearly two inches across, which have a clammy smell suggestive of toadstools. Then the tree becomes a thing of real though fantastic beauty.

The yellowish fruit which follows was relished by the Indians as a food, and they used the fiber from the leaves for weaving baskets, ropes, and other articles. And—as if to prove its versatility in a region supposed to be devoid of all comforts—the stems provided a pulp which the Indians used for soap.

The wood of the Joshua tree, spongy, tough, and pliable, is quite extensively used for making surgeon's splints and to a less extent in the manufacture of artificial limbs.

The Joshua is a true, loyal child of the desert and is found in the arid sections of Arizona, Utah, and California, especially in the Mojave Desert. The finer specimens are 25 to 30 feet high.

Photo by C C Pierce

EVEN the stately desert palm (*Washingtonia filifera*) serves man. Although the meat of the berries is too thin to be of any great value, the Indians formerly utilized them for food. Also they use the leaves *(below)* to this day for purposes of thatching. The small, yellow-brown berries, each with a proportionately large, brown seed inside, are borne in clusters from eight to twelve feet in length.

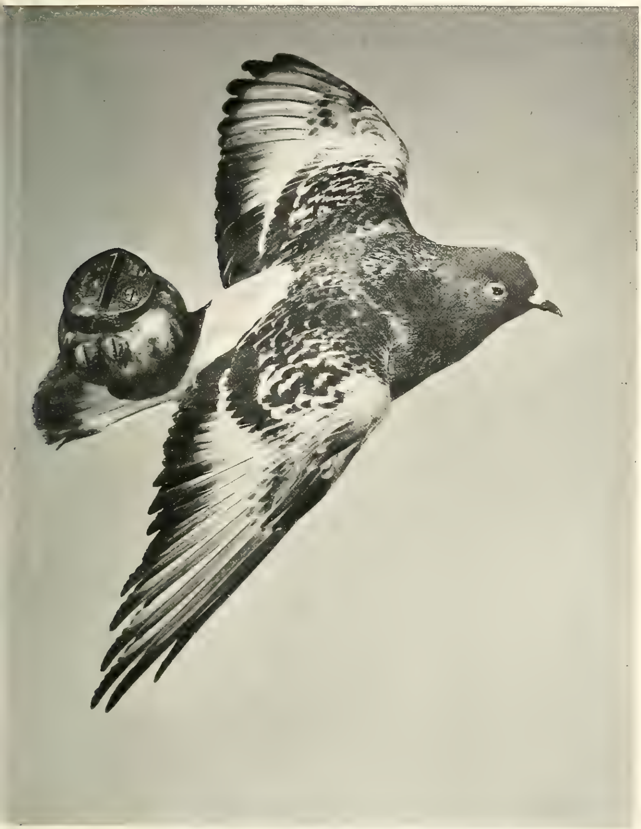
Popularly known as the Washington palm in honor of our first President, the average height of these trees is from 30 to 50 feet but many of them tower to 80 feet or more, and the columnar trunks sometimes measure nearly three feet in diameter at the base. The petticoat effect is formed by the old leaves, which gradually turn brown and droop against the trunk. In a natural state they clothe the trunk with a heavy skirt but in most cases fire has destroyed much of this covering, strangely with no apparent damage to the tree itself.

This picturesque tree is probably one of the oldest of our desert plants and may have lived where it does before the desert came. According to this theory, it is a "hang-over" from a time when a great inland sea covered much or all of that part of California now designated as Salton Sink. Thus the large, fan-shaped leaves which now rustle in the hot, dry wind from off the furnace-like sand, may once have gently swayed in cool, moisture-laden breezes blowing across a nearby sea.

The Washington palm is found wild principally in the western portions of the Colorado Desert of California but is scattered as far south as the Gulf of California in Mexico.

In many curious ways the plants of the desert have adapted themselves to life under conditions of extreme heat and dryness, yet in the process they have not lost their usefulness. Queer, grotesque, and often dwarfed, they ever seem ferociously on the defensive, yet they yield their manna to man, and to his aesthetic sense they lend their peaceful beauty.

WHERE PIGEONS WHISTLE

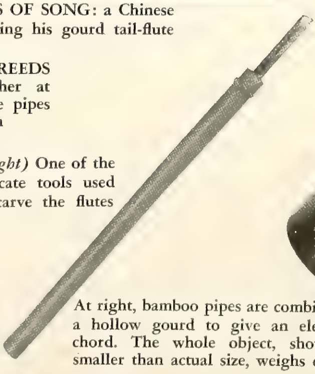


PAST MASTERS of delicacy in the diminutive, the artists of China have given the world an amazing variety of charming bibelots. The pigeon flutes displayed on this page are excellent examples of their peculiar inspiration, and it seems unlikely that any other people would hit upon the delightful notion of making their pet birds fly to the strains of music like that of an aeolian harp.

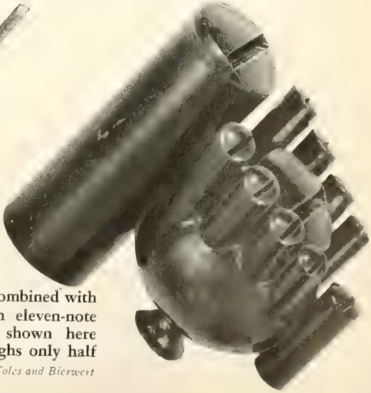
Pigeon raising in China is of ancient origin, but the tail-borne flutes date from 1662. Before that time, small silver bells were used to scare off hawks. Once invented, the flutes evolved rapidly, from a single-noted pipe to complex devices like the one immediately below, which combines a hollow gourd with ten bamboo cylinders each playing a different note. Accurate measurements and individual fittings were necessary to ensure a correct angle against the wind before the flute was attached to the pigeon's tail feathers by means of a metal ring. Smaller flutes produced higher notes and were reserved for female birds. Chinese daintiness also directed the convention of carving flutes in pairs and calling them male and female.

ON WINGS OF SONG: a Chinese pigeon wearing his gourd tail-flute

BAMBOO REEDS glued together at left resemble pipes of Pan



(Right) One of the delicate tools used to carve the flutes



At right, bamboo pipes are combined with a hollow gourd to give an eleven-note chord. The whole object, shown here smaller than actual size, weighs only half an ounce

AMNH photos by Coles and Bierwert

TOO CLOSE

By Robert H. Rockwell

True bear stories that show what you might expect o

T[illegible] tender age. Our earliest childhood interest was often stimulated by a thrilling bedtime story, when we were regaled and often terrified by blood-curdling yarns of being chased by bears. Whether these stories were true or not made little difference at the time. We liked to believe them and pass them on from one generation to another, often adding our own version of startling details with a more or less Machiavellian touch.

But it is not without reason that a reputation of ferocity in bears has come down through the centuries, perhaps from as far back as primitive man, who probably had to defend himself against the huge, prehistoric cave bear with crude and ineffective weapons. The advent of accurate firearms in modern times has had some effect in modifying the aggressiveness of these large carnivorous beasts, but even today bears may truly be considered dangerous animals. In fact, more dangerous than any other game in North America.

It should not be inferred, however, that bears are bloodthirsty monsters. In most cases they prefer to retreat out of man's way; but when aroused to anger or when wounded they sometimes attack with devastating fury, and occasionally with fatal results. In a wild state bears do not appear to possess any craving for human flesh. Unlike the man-eating tiger or lion, they do not lie in wait to pounce on people from ambush. Of the seven brown bears I hunted on previous expeditions in Alaska, none made any effort to charge, but even so, this was probably a matter of luck. All experienced woodsmen have wholesome respect for bears, whether they are brown, black, or polar, and especially a she-bear accompanied by a pair of young cubs.

Last summer our party of four, under the leadership and sponsorship of Mr. Richard K. Mellon and operating from the yacht *Electra,* hunted on the islands of Baranof, Chichagof and Admiralty. Fifty-two bears in all were sighted, and several fine specimens were procured. While most of these were killed at fairly close range by well placed shots, obviously eliminating the possibility of a charge, to say that there was no excitement on the trip would be far from the truth. Each encounter had its quota of thrills and disappointments, all of which furnished no end of after-dinner talk and good-natured banter, which often continued far into the night.

On board the yacht a spirit of good fellowship prevailed. Our crew of five was adequate; each one seemed to enjoy his job. We had a good captain on the bridge and a skilled chef in the galley. Formalities were cut or discarded when we cast off our lines at the dock in Ketchikan.

Of several fascinating incidents that I recall, one occurred when the bear came walking up to the hunter instead of the hunter trailing the bear. Dick Mellon and Bruce Johnstone, his guide, had spent most of the morning exploring the shoals of a salmon stream with few signs of bear in evidence. They had pulled their canoe past an eddy into quiet water, tying up against a long, half-submerged log. As it was near noon, they ate their lunch, had a smoke, and kept a sharp lookout for game along both sides of the stream. Close to their canoe, a narrow, elevated bank projected well out into the water, commanding an excellent view. Here Bruce stepped ashore into the timber, leaving his gun behind, and stationed himself on the extreme point, where he then sat down at the base of two huge tree trunks. The day was warm, and Dick in the canoe dozed, but he was suddenly awakened by the sharp snap of a breaking branch. Looking up 20 feet above him, he was startled by the cause of the commotion!

Close by, a large male black bear was deliberately walking along the margin of the bank and had almost reached the spot where Bruce was sitting unarmed and entirely unaware that a bear was snooping about, almost looking over his shoulder! As the bear raised his head to make a further advance, Dick picked up his rifle from the bottom of the canoe. At the echo of the first shot, the bear rolled over into a depression on the opposite side of the bank, while Dick scrambled quickly up the slippery slope and pointed his gun downward, killing the growling animal among the tree trunks directly below him. Bruce, with a smile of relief on his face, emerged from behind the tree and retrieved his gun.

Mrs. Mellon probably came as close to a bear as anyone would want to be. She was walking one day, near some high grass on the densely wooded bank of a rocky stream, when her guide heard a noise close by in some high, tangled vegetation. They both advanced, with Connie holding her rifle ready. Just then three brown bear cubs scuttled out almost under their feet from the underbrush. One climbed a tree over their heads and started crying for its parent. Very soon the bushes began to weave and snap near them, and presently the big head of a she-bear emerged, growling and champing in a most menacing manner. Mrs. Mellon started to take aim at the head, which was not

TO BEARS

ne of America's most formidable animals at close range

more than fifteen paces away, but her guide stepped directly in front of her, yelling, "Don't shoot, don't shoot!" The bear slipped back into the brush, her cubs followed, and that was the last seen of them. None of us blamed Mrs. Mellon for being perturbed by this interference of the guide, but it created a humorous byword on board: "Don't shoot, don't shoot!"

Many sportsmen will agree that the last day of a hunt, sometimes the last mile on the way back to camp, has produced luck and thrills beyond their most hopeful conjecture. Dick and Bruce were not overexuberant when they left the *Electra* in their outboard motorboat on the final day of the hunt. Their motor made a loud racket which echoed from the close cliffs as they headed towards Walker Cove for black bear. It was early morning when they reached the river. Overhead, white cloud banks hung in long, fleecy streaks half way up the steep mountains, as their boat entered the smooth waters of the river. They came to anchor on a wide verdant delta where sleepy flocks of gulls walked listlessly about and wailed in a melancholy manner. The tide had fallen and great schools of silver salmon were clearly visible, working up stream in the shallow water on their way to gravel spawning grounds and to the end of their cycle of life, for after spawning they die. There seemed to be as many dead fish as live ones; the banks reeked with the stench of their rotting bodies. Every pool and riffle was actually crowded to capacity. Some were lively but were changing color, some were fighting each other to guard the spawn. Others appeared in all the various stages of decomposition with their fins frayed, their bodies bruised, rising half out of the water, gasping and swimming aimlessly about, struggling against a relentless fate that had sent them to spawn in the same stream in which they were hatched. Now that their mission was completed nature decreed that they should die.

Bruce surveyed the banks and sand bars without finding fresh signs of bear. The track of a man's boot showed up in the sands, which, Bruce explained, was probably the footprint of a hunter of seals and eagles. These lonely wanderers find their way into every cove on the Alaskan coast. The Government pays them three dollars bounty on every seal head-skin and one dollar on every pair of eagle feet. They are mostly men who are bored with civilization and prefer to garner a meager existence in the wilderness. Human tracks in the sand were not reassuring to Dick or Bruce. They figured that the seal hunter might have had a hand in reducing the bear population in this section of the country.

About a mile up the river they sighted two black bear cubs playing on a sand bar and catching salmon in the riffles. These two husky cubs were having sport with the salmon. They ate a bite from each fish they caught, left it on the bank, and then dashed into the water after another. Screened behind spruce trees, Dick and Bruce watched these "babes in the woods" as they played and fished with as much pleasure as small boys. The cubs seemed to be on their own. Bruce concluded that since the parent bear was nowhere in evidence, she might have been shot, and that here were two orphan cubs starting out to shift for themselves.

The hunters moved closer; the cubs, seeing them, became badly frightened, rushed for the dense timber and very quickly climbed a 40-foot spruce that grew out of a projecting mound of earth and massive, moss-covered logs. With rifle ready, Dick circled one side of the mound close to the tree up which the bears had climbed. Bruce went around the other side. Thick brush held them back and huge hemlocks overhead darkened the ground below. Dick could not see what happened but he heard the loud report of a gun on Bruce's side of the mound. For some moments everything was quiet, and Dick concluded that Bruce had probably fired to scare the cubs higher up the tree. He climbed up over the mound, and a ghastly sight met his eyes.

Bruce was down on his back in a shallow mudhole, with his rifle under him and a bear on top, snapping at his face. With only his bare hands clutching the animal's lower jaw and the hair of her right cheek in a death grip, Bruce was holding the head away from his face and yelling to Dick: "Shoot, shoot quick! I can't hold her much longer!" With prompt decision, Dick put the muzzle of his Springfield close to the bear's shoulder, but noticed Bruce's leg sticking out underneath the bear in direct alignment with the rifle barrel. With a quick change, he lowered the butt of the gun and poked the muzzle up under the bear's throat, firing upward into the brain and killing her instantly.

Bruce's face and hair were covered with blood, and Dick thought the bear had about finished him. He at once rolled the bear off; and it was some time before Bruce recovered from the shock and struggle. But strange to say, aside from a sprained knee, there was no other injury on his body. All the blood on his face had poured out of the bear. Bruce had shot her [illegible] enough to stop her charge. Dick's cool, deliberate [illegible] have had a tragic end.

[illegible] undemonstrative mood. After summing up briefly what happened, his only remark was, "You know, [illegible]

[illegible] help, Bruce rested under the tree that the cubs had climbed.

[illegible] ropes and other equipment to take the cubs alive. The [illegible] to the bears and without getting clawed or bitten ourselves. This did not prove as easy as it seemed. They were strong, healthy animals, weighing about 50 pounds each. They fought us tooth and claw, with amazing ferocity. There was considerable confusion around the "bear tree." Each of us had a different plan, but our chief officer, Raymond Veatch, presented the most effective device, which was a lasso on the end of a ten-foot bamboo pole. At first the cubs looked down on us with calm indifference. As the [illegible] over their heads, they either leaped through it, or dived past it among a maze of branches. It seemed like a hopeless procedure until the smaller of the two cubs became alarmed and, descending the tree backwards, tried to make his escape. Veatch grabbed him quickly by the scruff of the neck. I held his left legs, and the mate grabbed his right legs. His efforts to get hold of us were terrific. He was a picture of outraged fury and he snapped at everything that came within his reach, even biting holes in the Captain's rubber boots. It required five of us to hold him down. We tied his feet, and I made a muzzle out of two-ply, heavy codfish line, fastening it over his jaws so he could be carried to the beach.

Then we went after the larger cub. He was stronger and even more difficult than the first. In the tangle of spruce branches, we encountered great difficulty in getting the noose over his neck. Time and again he flipped it aside amid unprintable ejaculations on our part. Just as I was about to climb the tree, Veatch made a lucky pass. The noose tightened, but in the struggle that followed, the bear became strangled, and when we lowered him to the ground he passed out. I quickly loosened the rope. His paws were limp and his eyes glassy. I gave him first aid by working his legs backward and forward, and in a little while he gasped, came to, and began at once to fight us again. But by this time, his feet were tied and a rope muzzle prevented him from doing much damage with his teeth.

We got the cubs aboard the *Electra* at last, and made a roomy box for them. Then they quieted down and even lapped up milk that we gave them in a saucer. As I write this they are now probably engaged in a frolic or basking in social security at the Pittsburgh Zoo.

A SOJOURN of six months on Midway Islands, of the Hawaiian group, in 1939-40 brought me into intimate contact with some of the [illegible] remaining Hawaiian monk seals (*Monachus schauinslandi*). Today this is one of the rarest and most restricted of all the seal family.

It was probably quite abundant on the islands until early in the nineteenth century when the oil and hides became exploited commercially. We find it recorded that in 1824 the brig *Aiona* engaged in a sealing expedition to the remote islands which resulted in a great reduction in their numbers, and a while later the seals were believed to be almost exterminated. A few years after, however, their numbers had greatly recovered, for in 1859 a Honolulu newspaper, the *Polynesian*, reported the return of the bark *Gambia* with over 1500 skins obtained on the northwestern islands.

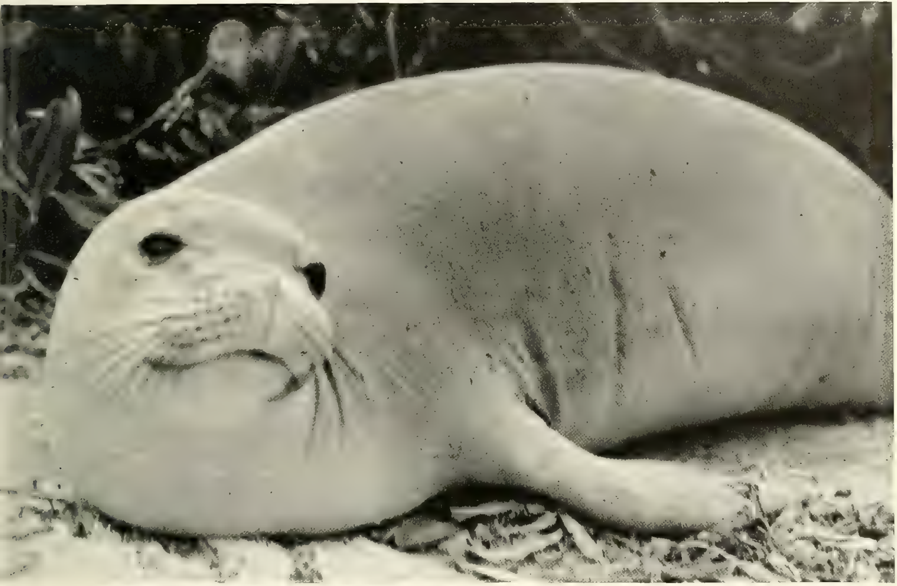
In the following years the Hawaiian seal was most likely the object of much persecution on a smaller scale. Its survival on these remote islands was probably due to a drop in the value of seal oil through the growth of the petroleum industry and to protection in more recent times by the United States Government. Since 1909 these islands (with the exception of Midway, which is under the U.S. Navy Department) have been designated the Hawaiian Bird Reservation. In spite of this protection, in 1910 the Coast Guard cutter *Thetis* found and arrested 23 Japanese who were slaughtering birds for commercial purposes.

The Hawaiian seal did not become known to scientists until 1905, when it was established as a distinct species. While it is not closely related to the seals of the Pacific mainland, it is closely related to two other species of tropical or subtropical seas. These are the West Indian monk seals, said to have come to the notice of Columbus on his voyage of 1494, and the monk seal of the Mediterranean, Black Sea, and adjacent coasts of Africa and Europe, even to Madeira and the Canary Islands. One distinguishing feature of the monk seal is that all the claws of the feet are either absent or rudimentary.

During my stay at Midway, four of the seals frequented the beaches of Eastern Island, and occasionally one or two were seen on the shore of nearby Sand Island, perhaps some of the same individuals. The Hawaiian monk seal does not migrate. Like many other seals, it probably feeds on squid as well as fish; and as both are abundant here, the ones I saw apparently make an easy living, for they spent most of the day sleeping and basking in the sun. They showed no alarm until closely approached, whereupon they shuffled off at great speed and entered the water. If cornered, they threatened the intruder, opening their mouths widely as they lurched forward and upward as if to attack, uttering an abrupt, barking noise at the same time.

RAREST SEAL

By THOMAS M. BLACKMAN



(Above) NATIVE of Midway Islands is the unique Hawaiian monk seal who has no claws and does not migrate

DISTURBED—but no longer by oil and hide exploiters. These Government protégés now bask in security

PLUNGING over a coral reef. Scars indicate that seals do not always escape injury from sharp coral

CANINE FISHERMEN

Accounts of some dogs that went a-fishing

By E. W. GUDGER

[illegible]

In [illegible] NATURAL HISTORY Magazine [illegible] "Dogs as Fishermen." [illegible] to many people. Some of these letters [illegible] by dogs and others called attention to [illegible]. The information was all filed away, and further facts were added as they came [illegible]. And now after these years it seems worth while to bring together all these interesting accounts with some photographs of dogs catching fishes into a second article, which I hope may bring pleasure to the far larger number of readers of the present-day NATURAL HISTORY.

Dogs co-operate with fishermen

Since earliest times, man's oldest friend has won admiration for his loyal spirit of co-operation in hunting, in defending his master's property, and in many other ways. The dog's skill as a fisherman is the more marvelous because he is not equipped with claws as is the cat or the bear. He has to catch the fishes in his mouth, and he probably cannot see any too well underwater. His skill as a fisherman is, therefore, another illustration of the dog's wonderful initiative and mental versatility.

The simplest form of fishing by dogs is done in co-operation with their masters—sometimes net fishermen and sometimes anglers. Some years ago William Jones recorded the following performance he witnessed by trained dogs in Wales:

> The fishermen commenced their operations at every ebbing of the tide by stretching a seine across the river several hundred yards above the coast, and whilst drawing it towards the sea they incessantly disturbed the water by beating the surface as well as by hurling into it the heaviest stones they could raise. The affrighted fish made at once for the sea, which, however, they could not reach except by passing through the intervening shallows. Here they were pursued by dogs trained for the purpose, and clubbed or speared by the men. I have frequently seen from [illegible] to 2[illegible] fine fish, weighing from [illegible] to 2[illegible] pounds each, taken in this extraordinary way.

That trained-dog helpers are not unknown in the Wales of today is attested by the next incident. In this case the dogs seemed to act more on their own initiative. This interesting personal observation is contained in a letter from Mr. Frank H. Cauty of New York City.

Mr. Cauty [illegible] at Rhos [illegible] Colwyn Bay [illegible] North Wales [illegible] V-shaped weirs or traps. These were constructed of stones loosely piled to make long platforms, on each of which a fence was constructed of posts with intertwined willow bark. At high tide this trap was completely submerged, and during the ebb the fish were enclosed in it as the water ran out between the stones. At low neap tides the interior of the trap was practically drained and the fish were caught with landing nets.

Not so, however, if winds held the tides in, and particularly not so at low spring tides, when a pool 60 or 70 yards long and three feet deep was left at the apex of the V-shaped trap. Then the dogs came into play—and the fun began.

> Dogs have been used for generations to catch the larger fishes that are thus imprisoned. These fishes are usually salmon and mackerel. The dogs are very clever at their work. They constantly leap from the water with great splashes. I do not believe that this is done so much for making the splash as for the better opportunity of seeing the fish when they leap. They will chase the fishes into the shallower water, and if there are mackerel each dog will jump on one, put a foot on its head, pick it up in his mouth, lay it on the sand and go back for more.
>
> I have never seen a dog tear a fish and I was astonished on a visit in 1915 to watch the extremely accurate way in which they pin a mackerel down.
>
> With salmon their method is different. Each dog will chase one into the shallows and when it is in [illegible] difficulty will [illegible] it with nose or body directing it farther ashore. They will then grasp it by the dorsal fin and carry it to the sand. As soon as the fish is landed the dog's interest appears to cease entirely. I never saw a dog watch a fish or attempt to eat it after landing it.
>
> I saw this performance frequently when a child 40 years ago, and the method was quite unchanged when I returned to Rhos in the summer of 1915. Then I saw the dogs fish probably every other day. The dogs used are retrievers, and there was an old one and a young. I was told that there was no attempt made by men to teach the young ones. The puppy is started with the old dog and soon imitates its example.

These dogs, at low spring tides, evidently did all the fish-catching, and they showed a high order of intelligence and initiative. Especially interesting is it to notice that the old dogs trained the young ones. An instance of like kind was given in my earlier article.

In writing of his fishing experiences in Sutherlandshire in Scotland as far back as 18[illegible], Charles William George St. John tells of a dog who always insisted on aiding the angler in landing his catch. Here is how he did it.

> . . . Another retriever always took the most lively interest in my fishing, watching the fly and getting into a state of great excitement whenever I hooked a fish. Indeed if allowed to do so he would go in and land the fish, taking it carefully and delicately by the back in his teeth. But as he often got entangled in the line and did mischief, I was obliged to stop him. A

great treat, however, to this dog was to have some living sea trout put into any shallow pool where he could catch them and bring them one by one to whoever carried the fishing basket.

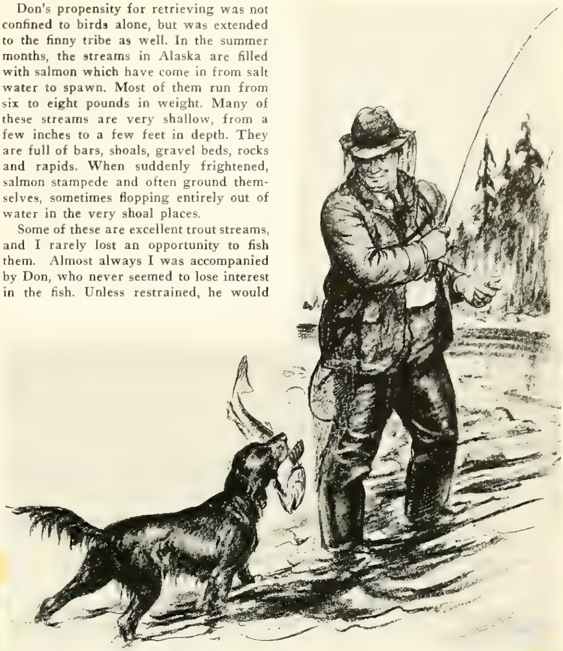
Apparently it is not at all unusual for dogs to catch fish and bring them to their masters. Here is another case—this time from Germany. Herr H. Vogler had a number of long-haired retrievers who used to fish in running water without much success. But one, on hand when a fish pond was being seined, took all the carp out of the net as it came in and carried them off. To get these he had to put his entire head underwater for each fish. This same dog used to catch fish in a deep pool in the garden and bring them "triumphantly" to his master in the house. "For this heroic deed, he openly desired praise."

Admiral Hugh Rodman, U. S. N., published an article in 1932 in which he tells how his dog, a Gordon setter named Don, would help him catch fish.

Don's propensity for retrieving was not confined to birds alone, but was extended to the finny tribe as well. In the summer months, the streams in Alaska are filled with salmon which have come in from salt water to spawn. Most of them run from six to eight pounds in weight. Many of these streams are very shallow, from a few inches to a few feet in depth. They are full of bars, shoals, gravel beds, rocks and rapids. When suddenly frightened, salmon stampede and often ground themselves, sometimes flopping entirely out of water in the very shoal places.

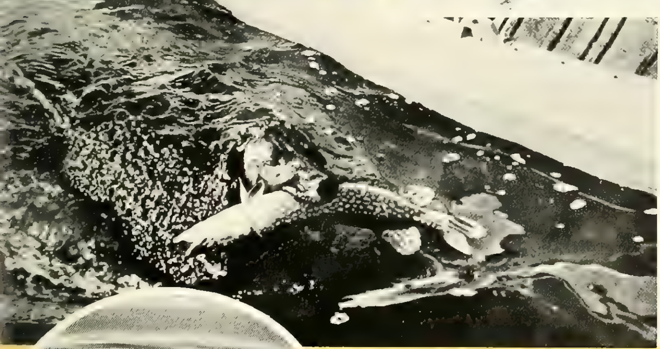
Some of these are excellent trout streams, and I rarely lost an opportunity to fish them. Almost always I was accompanied by Don, who never seemed to lose interest in the fish. Unless restrained, he would rush into the shallows, in the midst of a big school of fish, which would scatter in panic. Some would ground themselves and become more or less helpless.

Thereupon Don would grab one about its midship section and attempt to bring it to me. Often it looked as if Don's head would be all but twisted off by the strong muscular exertion of the salmon. Inasmuch as he seemed to enjoy it so thoroughly, and because a few fish more or less would make little or no difference among the countless thousands, I let him gratify his pleasure to a limited extent before checking him.



Courtesy Field & Stream

DON, a Gordon setter caught many squirming salmon whose strength sorely taxed his neck, and gave them proudly to his master



(Left) **CURLEY, a spaniel, retrieved the fish his master hooked, in this case a four-pound pike**

THE large dog at lower left proved himself a good fisher in a rocky cove in northwestern Mexico

Acme Newspictures, Inc.

Cut by courtesy Field & Stream

Accompanying this interesting article is the equally interesting picture which I am privileged to reproduce here. This shows Don triumphantly bringing a salmon to his master.

The next incident comes from a newspaper, but its accuracy is guaranteed by the accompanying spirited photograph. This shows that Bill Brokaw

THE "Labrador" at left, trained by Col. Henstock to retrieve game in India, surprised her master by voluntarily aiding him in fetching fish. When a two-and-a-half pounder was hooked in water up to her withers, she had difficulty in pushing it to the bottom to grip it with her mouth but she managed to bring it ashore

of [illegible], Minnesota, has a real fishing dog. The [illegible], [illegible] by name, has been trained to retrieve the fishes his master may catch. Here he is shown bringing in a four-pound pike hooked by his master in Pelican Lake, Minnesota, in 1938.

In [illegible], Laurence M. Huey described a most unusual occurrence at Sonoyta, Sonora, in the northern part of the Gulf of Lower California. A large school of the fish called "corbina," the Pacific counterpart of the Atlantic weakfish, rounded up a shoal of sardines and pursued and pursuers jammed themselves into a small rock-embraced cove in which the water was only about three feet deep. All the villagers flocked to the shore and most of the men waded in and began to throw the large fish onto shore. Thus encouraged, "A large dog proved himself to be a good fisher, and, watching his chance, would seize a fish by its back and bring it to shore, where he would bite its head until it stopped struggling, and would then dash back for another"—as may be seen in the accompanying photograph.

Here is a brief account which shows how a dog that was not trained as a fisherman rose to the occasion when called upon to aid his master.

[illegible] Mr. [illegible] [illegible] [illegible] [illegible] minute or two later heard a slight noise behind me, looked around, and saw the [illegible] dropped back into the water.

I was too far away to do anything, so I called to my [illegible] terrier which was lying on the bank looking rather surprised at the fish returning to the river. 'Go on, fetch it, Jock,' I cried. Into the river went Jock, collected it, brought it out in his mouth, put it down on the bank, and lay down again.

. . . what struck me so curious in this instance was that the dog made no attempt to bring the fish to me, but put it back on the bank and then lay down again, as if to show that he realized that his job was done."

Mr. C. D. [illegible]'s Sealyham terrier did, for a dog of his age, a rather unusual thing in September, 1939. This is described thus by his master:

I hooked a half-pound trout but had no landing net with me. Having played it for some time and failed to land it, my Sealyham dog—who, incidentally, is seventeen years old—jumped into the water, which was about one foot deep. He made several attempts to get the fish, and, at the sixth, caught it. He brought it onto the bank and

The mournful collie below dreads the cold water of a stream near Selkirk, Scotland, but the sight of leaping salmon and the pangs of hunger finally cause him to try his luck at fishing

IN HE GOES "all over," emerging with his breakfast in his jaws, as illustrated below. Without waiting to dry, he eats his catch in short order

gave it to me. It should be noted that this dog had never been trained to retrieve —even on land. This action was entirely of the dog's own volition.

A. Croxton Smith relates two interesting accounts of fishing dogs which he calls Labradors [i.e., presumably crosses between setters or strong spaniels and a Newfoundland]. The first dog was bred in India and taken by her master, Col. Henstock on a fishing trip to Baluchistan after mahseer—a kind of barbel. This dog had been trained to retrieve mixed game on land, but of her exploits in water Smith writes as follows:

> She had never tried her hand at fish until this particular occasion. Each time he [her master] hooked one and was playing it she whined and quivered with excitement, so that eventually, when he got on a small one in shallow water, he let her fetch it. Another time he hooked a two-and-a-half pounder in water that was up to her withers, and she had to make many attempts before she was able to push it on the bottom in order to get a grip on it with her mouth. She brought it back, dropped it hurriedly at his feet with rather an expression of disgust, and then sat down a yard or two away. She was ready for the next.

The accompanying photograph taken by Col. Henstock's native bearer, shows the dog bringing in her master's catch.

Dogs fishing for food

From serving as efficient helpers to their fishermen masters, it is not a far cry to finding dogs which fish for their daily food. As shown in my previous article, this is particularly true of dogs living in arctic and subarctic regions where their chief food is fish. But first let us go to a region nearer at hand—to Scotland. One wonders why the dogs concerned preferred the dead fishes to the live ones. In St. John's *Tour in Sutherlandshire* this interesting occurrence is noted:

> While fishing . . . one day . . . my attention was attracted to a terrier I had with me, who was busily employed in turning up stones near the water's edge, evidently in search of some sort of food. On examining his proceedings, I found that under most of the stones were a number of very small eels. When the ground was quite dry, the little fish were dead and those the dog ate; but under the wet stones they were alive and wriggled rapidly away toward the stream.

This recalls the story in my earlier article of a dog in Normandy which used to go out fishing on the sands when the tide was out. Here the beach showed scattered small mounds. To certain of these the dog would dash,

Dogs develop individual methods. A drooping tail bespeaks this short-haired dog's reluctance to venture far in the Scottish river aptly named Cauld

But when the salmon leaps near shore, the alert dog dashes in with tail waving and captures his breakfast, as shown in the photograph at bottom

Globe Photos

[illegible] sand.

[illegible] and eating immature salmon that had been caught higher up stream, gaffed and then thrown back into the water. Here is what [illegible] writes:

> The [illegible] dog was fat and sleek to [illegible] and would take a regular header when the dead fish was in deep water and would [illegible] it from a depth of fully eight feet. He knew his business well and never hunted the streams, but went from eddy to eddy and searched the backwaters till he found his breakfast, and when this lay in a deep place he would often have to make many dives before it was secured.

However, there are in Scotland fishing dogs that prefer live salmon to dead ones. Furthermore, certain individual dogs have developed their own techniques for getting their breakfast—as the photographs show.

Near Selkirk the salmon, in going up stream to spawn have to ascend some rapids. On the bank of the stream a hungry collie sits mournfully watching the fish and dreading the cold water. Finally, however, sight of the leaping fish plus the pangs of hunger overcome the dog's dread of the water. In he goes "all over," comes out dripping but with the salmon in his jaws. Without waiting to dry, his breakfast is eaten in short order.

But there are other streams in Scotland with leaping salmon in their rapids and other hungry dogs waiting on the bank. The next figure shows a short-haired dog watching for his breakfast to come closer inshore. The stream is called Cauld and that accurately describes its temperature. The dog is short-haired and the fish is far out. The dog is dejected, as the drooping tail plainly tells. However, a salmon inadvertently comes near the bank. The alert dog with waving tail dashes for it. The third picture of the trilogy shows that another shivering Scottish dog has his breakfast provided from the nearby stream.

Mr. Charles W. Townsend wrote from Boston in 1924 of his interest in my "Dogs as Fishermen" and quoted the following account recorded in his book *Sand Dunes and Salt Marshes*. "I have seen Eskimo dogs that were kept on rocky islands on the Eastern Labrador Coast (near Battle Harbour) forage through the [illegible] waters [illegible] and spend much of their time in this pursuit." Then he adds, "I believe that they were catching cod there and that they depended on them for a livelihood as they were not fed. I have seen them on the Southern Coast catching and eating capelin."

It is well known that in Kamchatka and Siberia, the dogs which in winter are fed on dried salmon are turned loose in summer to forage for themselves. Since the streams are then filled with spawning salmon, the dogs find it easier to catch these than to hunt for prey through the woods. When Mr. George Kennan, the well-known Siberian explorer, read my earlier article, he kindly communicated some observations of his own. I quote from his letter.

> I have read with great interest your article on "Dogs as Fishermen" in NATURAL HISTORY for November-December 1923 and I wish to add another case to those you have cited. In my early manhood I spent three years in Northeastern Siberia and two summers at Gizhiga on the coast of the Okhotsk Sea. I have many times seen our sledge dogs wade out belly-deep into the water of the Gizhiga River when salmon were running up in the summer, watch until a fish of suitable size came along and then seize it under the water and gallop ashore with it. These dogs were only long domesticated wolves, and their ancestors may have had this habit in a wild state.

Let us now go to the sunny south—to the Gulf of Mexico, to Sanibel Island, Florida, in the latitude of Fort Myers and Lake Okeechobee. On this island, Mrs. L. M. Perry has for a score of years had a winter home, and her front yard extends down to the water's edge. This in former days was very much to the advantage of Dom, her black Scottie. For when he felt the pangs of hunger, he used to take prompt action to relieve those pangs. Of his former exploits his mistress wrote me in December, 1940.

> Poor old Dom is past the days when it was sport to catch fishes and to joust with crabs, and he is disillusioned even with mice. But in his heyday it was a regular pastime with him to go down at high tide for his ration of fresh fish. He knew perfectly well the state of the tide when schools of little fish would be swimming along close inshore, and he would wade back and forth along the shallows snapping up mouthfuls of small fish and eating them with evident relish. I never saw him catch any that he did not eat, and it seemed perfectly evident that the whole thing was to him much like fishing—both for food and fun—is for a fisherman.
>
> He did this for many successive seasons and he did not always wait for me to go out with him. I've seen him go out to the beach alone and wade after his treat. No one taught him to fish. He took it up entirely of himself. It is too bad that he can no longer keep it up. Unfortunately I never took any photographs of any of Dom's fishing exploits.

Dogs fishing for sport

In 1923 I recounted a number of instances wherein dogs seemed to fish simply and entirely for sport. Some of the accounts in the preceding section of this article have been hard to classify. They might have been included in this section. At any rate they surely contained much of the idea that the dogs greatly enjoyed the catching.

T. E. Donne in a chapter on "Poaching and Poachers" in his interesting and informative book, *Rod Fishing in New Zealand Waters*, relates the following account of a poaching dog. Apparently the dog caught the fish for fun rather than for food.

> One evening I was kneeling in brushwood and fishing at the top of a river pool, when I saw a black retriever dog creeping through some fairly high vegetation on the opposite side of the river. He crept forward slowly, looking down into the water. I remained quiet. The dog came gradually to the edge of the bank and crouched there quite still; after several minutes had elapsed he sprang right under the water and swam downstream, along the bank, coming to the surface some fifteen feet from where he dived; he had a trout of two and one-half to three pounds in his mouth. At once I bombarded him with stones, but he stuck to the trout and swam to the tail end of the pool, scrambled up a low bank, made off along an old watercourse and was soon hidden from my view in long grass.

On mentioning to Mr. George Goodwin, of the Department of Mammalogy in the American Museum, that I was at work on this article, he related to me the following personal observation of a fishing dog.

> In England, many years ago, most of the fields used to have what was known as a "marl pit." It was an old-time custom to spread the marl on the land to raise grain crops. For years, these pits have been full of water and at some early date were stocked with golden carp. During the summer months the water in the pits often became low.
>
> When I was a boy living in England, I had a fox terrier that would actually go fishing and successfully retrieve fish from these pits when the water was not too high. He would wade in and watch for a movement among the weeds and then his head would go under the water and he would snap in several directions—sometimes without success. Returning to a higher point of vantage he would watch and frequently would give the weeds a tap with his paw in order to get the fish to move. When he got a fish it was deposited at my feet unharmed. The fish was then trans-

ferred to a large stone tank of cool running spring water to harden and freshen the meat and make it eatable.

Our next account is from the magazine *Field* (London), but the reference has unfortunately been lost. George Beveridge quotes from the letter of a correspondent in Ross-shire, Scotland, as follows: "I have a dog which actually took out of a burn a sea-trout of about six pounds—surely a record for a collie dog. He saw the trout and chased it, lost it once but got it the second time."

In 1924 Prof. Ben F. Howell of Princeton University kindly wrote me of his pleasure in reading my 1923 article, and communicated a very detailed and most interesting account of the fishing habits of a dog that he had owned when a boy.

The dog was a half-breed pointer, one of the most intelligent animals I have ever known. He had been trained to point and retrieve, but had not, so far as I know, ever been taught by anyone to fish. I raised him from a pup, and he was the constant companion of my boyhood, always accompanying me and the other boys of my neighborhood on our daily visits to the "old swimming hole" in the summer. Just upstream from the swimming hole the brook was shallow (about a foot or eighteen inches deep), with a clean sand bottom. Minnows and other small fish an inch or two in length were always to be found in this shallow water when the swimming hole was occupied by the boys; and, while we boys disported ourselves in the hole, Don, the dog, amused himself by trying to catch the fish in the shallow. He would stand in the water (which reached part way up the sides of his body) and would watch the fish intently until one of them swam near enough so that he could reach it, when he would plunge his head into the water after it, or sometimes jump after it. I never saw him catch a fish, but, since he continued for years to fish in this way, I presume he must have captured one often enough to keep up his interest in the sport.

I think he must have taken up fishing as a pleasant means of passing away the time while we boys were swimming. He was fond of the water when a puppy, and probably first noticed the fish while wading about in the shallow water one day, when, having nothing else to interest him, he tried catching them, finding the sport so to his taste that he continued it. He very obviously enjoyed it, and would often indulge in it for a half hour or more at a time. Possibly one of the attractions was that the water kept him cool in the hot afternoons.

In April, 1927, my brother, David Gudger, wrote me of a fishing dog belonging to Dr. Henry Norris, who lived about three miles out of Georgetown, South Carolina.

I have found you a fishing dog, an Irish spaniel that tries to catch fish out of the basin of a fountain in his master's garden. I saw this dog stand on the rim of the basin intently watching something in the basin and then plunge in head first. Doctor Norris said that he was always trying to catch the perch therein, and that he had already caught the slower fish. The dog always wanted to go fishing with Doctor Norris and his friends, and when a fish was landed he would grab and shake it.

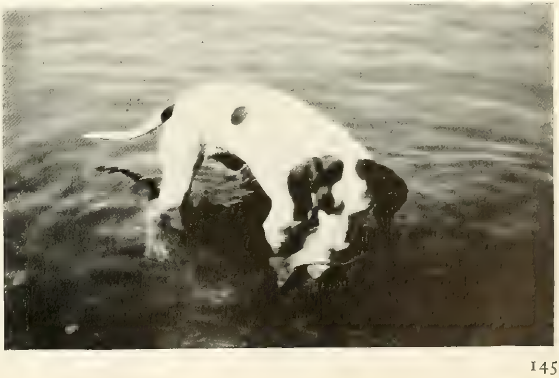
BOY, a blooded pointer, graduated from pointing birds to doing the same for fishes. In the clear water in front of the Indiana cottage where he lived, he took the initiative to develop a skill that would put any Izaak Walton to shame

I have previously given an account of the exploits of a dog in Newfoundland, who on his own initiative and opportunity and for "his own amusement" used to fish for sculpins from jutting stones. The fish were all carried to one place and laid in a pile. A. Croxton Smith (elsewhere herein quoted) relates a closely similar story of another dog in Newfoundland.

This dog, who was entirely black, with the exception of one white foot, used to keep his master's household well supplied with fish, doing it in this way. For hours together he would remain immovable on a small rock which projected into a stream (which was filled with fish to an extent one could scarcely believe), keeping his white foot hanging over the ledge as a lure to the fish. He remained so stationary that it acted as a very attractive bait; and whenever curiosity or hunger tempted any unwary fish to approach too close, the dog plunged in, seized his victim and carried him off to the foot of a neighboring tree; and on a successful day he would catch a great number.

WIND destroyed visibility, so he never went down to fish when it was blowing. Rising from a nap, he would gauge the sun's position (direct rays were better) and repair to his favorite hole. If no fish appeared, he would "pick up his can of worms" and move elsewhere. His batting average was high

Photos by courtesy of Mr. E. H. Scott



[illegible]

Remarkable in this account are the initiative and patience of the dog, his using his white foot as a lure, his catching the fish and piling them together in one place. Evidently all the dog's activities were motivated by a purely sporting impulse—which yielded his master, however, many palatable fishes. This is quite the best dog-fisherman story yet [illegible] better one is to follow.

In 1929, Mr. E. H. Scott of Richmond, Indiana, came into possession of a blooded pointer puppy named Tamarack Boy, "Boy" for short. This dog presently graduated from pointing birds to doing the same for fishes. For an interesting recital of these fish activities of Boy and of how he taught himself to catch fish, I am indebted to the kindness of Mr. Scott.

A summer season was spent at Lake George, Indiana, where strangely enough for a short-haired dog Boy liked the water and thoroughly enjoyed riding in the boat. Standing on the bow he would strike a pointing posture and ride across the lake, maintaining the intenseness of his point until we pulled up at the dock, unless a quick side motion of the boat pitched him into the water. But such a mishap had no lasting effect on his desire to go or on his riding position.

When in the boat, Boy would insist on picking up every dead fish he could see floating in the water, also on personally inspecting each fish taken off the hook before it was released or placed on the stringer. He had that persuasive way that would cause you to pull the boat out of its course so he could pick up a fish slightly out of his reach. Apparently asleep in the front end of the boat, he seemed to know when a fish was being landed. If my back was to him, as it frequently was, he would place his nose under my elbow, and with a quick [illegible]. He seemed to say: "Let me see that one." Just a sniff at the flopping fish was all he wanted, and he would go back and lie down, only to return again on the next take. During the week, when there was no one to go fishing with him he would look out across the water with an expression of longing equal to that of any veteran fisherman at a lake without tackle.

Just in front of our cottage the water was shallow and clear. Sunfish and bluegills would spawn in the early season. From a point of vantage on the boat landing, Boy would, on clear days, watch them fanning over their nests. The sight of these pan fish, and my absence, no doubt prompted him to go fishing alone. How [illegible]

[illegible] Lake George. His [illegible] increased. He soon learned that a slight ripple on the water destroyed the visibility. So when the wind was blowing at all, Boy did not go fishing. Next, he seemed to learn that the more direct the rays of the sun, the better he could see—and he confined his fishing to mid-day hours.

I have seen Boy wake up from his noonday nap—stretch himself—look up at the sky as if to locate the position of the sun—then walk directly to the water and without a moment's hesitation go out to his favorite spot and start fishing. He would stand as immovable as any pointer you ever saw with quail under his nose. With eyes glued to the water, he would wait and wait. If no fish appeared, he would very quietly move to a new spot, and do it just as deliberately as you ever saw a man pick up his pole and his can of worms and go downstream to the next fishing hole.

The patience of Boy's immediate ancestors in hunting quail in a country where few quail were to be found could be seen in his long waits for fish that did not always appear, and his lack of disappointment in those that got away. With a batting average that would not approach what would be called good in the major league, he never lost his enthusiasm or the love of the sport, but he did show much improvement as the years went by.

How did he do it? Frankly, I do not know, but I have stood on the sea wall overlooking the water and watched fish of various sizes and kinds swim between his legs and all around him. I have seen them nip at his legs and dart away, as though they were playing a game and getting a lot of fun out of it. Perhaps the explanation is that fish are attracted by hair—hence the buck tail bait. . . . If the fish are attracted by waving hair on the dog's legs, they may follow it upward sufficiently close to the surface and give him an opportunity to catch them. At any rate I have seen Boy slowly lift his foot before attempting to catch them. Like a good fisherman, he brings his fish still alive to the house with just as much pride as a barefoot boy would show on a similar occasion.

All of which causes me to wonder whether a little encouragement is not all that is needed for many a dog to develop an unexpected sport, which will prove as entertaining to the master as to the dog himself.

[illegible]

GEM FOR

Whoever wears the traditional bloodstone may claim its legendary powers, even over the wrath of kings and despots

IN the Middle Ages, when the art of gem engraving was little understood, images found upon stones were thought by many to be the work of nature or of some mysterious power, rather than the craftsmanship of man. They were valued accordingly. For a stone which today could be bought for very little, an Elector of Mainz offered the district of Amoneberg—and was refused.

The gem for March, according to general tradition, has been the bloodstone, or jasper; and this stone comes down to us with its share of supernatural lore. Legend has it that the drops of blood caused by the spear-thrust in Christ's side fell upon a green stone at the foot of the Cross to make the first bloodstone. One can imagine, therefore, that a stone showing Christ's head with blood spots on the features, looking for all the world as if they had fallen from the wreath of thorns about His head, would be regarded as holy, and it would be highly valued, and that it would be worn with superstitious awe.

One of the oldest legends of the bloodstone is responsible for the name "heliotrope" by which this gem is sometimes known. According to this story, a bloodstone placed in a bowl of water tinged the water red; and the reflection of the sun, seen in the bowl, also became red. Hence the nickname heliotrope, which means "sun turning." Prophets playing upon the superstitions of the people and their lack of curiosity for scientific fact, extended the magic of this stone still further, claiming that it had an actual power over the sun itself and could cause storms and tempests. By waiting until bad weather approached, they claimed to bring on storms and then professed to interpret future events as "told" to them by the howling winds—prognostications possible, of course, only to the supernaturally endowed.

Bloodstone is a variety of quartz, of which the amethyst is another variety.* Quartz is one of the common minerals, and since it is hard and comes in many colors it is inevitable that it should find wide use as a gem. Chalcedony (of which bloodstone is a variety) and jasper are finely crystalline varieties. In place of the

MARCH

By FREDERICK H. POUGH

Assistant Curator, Geology and Mineralogy
The American Museum of Natural History

Bloodstone figurines from China

large single crystals from which a transparent amethyst gem is cut, we have here a compact, opaque mass of many microscopically intergrown crystals. And whereas transparent gems are faceted, chalcedony is cut in rounded form. Bloodstone is a deep green from chlorite inclusions, and red spots are from iron oxide. Some gems show little red, others have abundant flecks.

The highly valued variety of chalcedony known as bloodstone was thought to be one of the most efficacious stones in the cure of bleeding. An interesting old book of 1483, *Hortus Sanitatis* by Johannis de Cuba, depicts what must have been, for that day, a scientific test of the value of the bloodstone in halting a nosebleed. Other myths attribute additional powers: the wearer will get whatever he asks for, he will be able to calm the wrath of kings and despots, and his statements will always be believed. (Perhaps some politicians use this gem today!) Other powers enable the owner of a bloodstone to open any door, burst bonds asunder, and level stone walls—by merely speaking the name engraved on it.

Today bloodstone is one of the commonest of gems and one of the least expensive. Most of the rough material comes from India, where it occurs with agate, carnelian, and chalcedony. However, there are many other sources—Brazil, Australia, and several places in the United States. The best stones are those in which the red flecks are not large but are fairly widely and uniformly distributed over the surface.

Jewelers have officially adopted an alternative stone for March, the aquamarine. Though lacking the justification of tradition, this gem is one of the most attractive of all the less valuable gems (the term "semi-precious" is no longer approved by jewelers). The aquamarine derives its name from its resemblance to the color of sea water; and individual stones vary, just as the sea does, from deep blue to pale blue-green. The most desirable are the deepest blues, which are available in considerable quantities, from Brazilian deposits. It has recently been discovered that a moderate heating renders the greenish stones bluer, presumably by driving off some of the yellow. Aquamarines have been found on every continent, and among the more important American localities are Maine, Massachusetts, Connecticut, North Carolina, Colorado, and California. The deeper shades, however, are rare.

Aquamarines were perhaps the original ouija boards. In the Middle Ages a beryl-set ring was suspended in a bowl of water, the edges of which were marked with the letters of the alphabet. Answers to questions were spelled out by the aquamarine as it stopped before successive letters. A man who held an aquamarine in his mouth could, it was thought, call the devil out of hell and force him to answer questions. Today, fortunately, we are more interested in the beauty than the utility of our birthstones.

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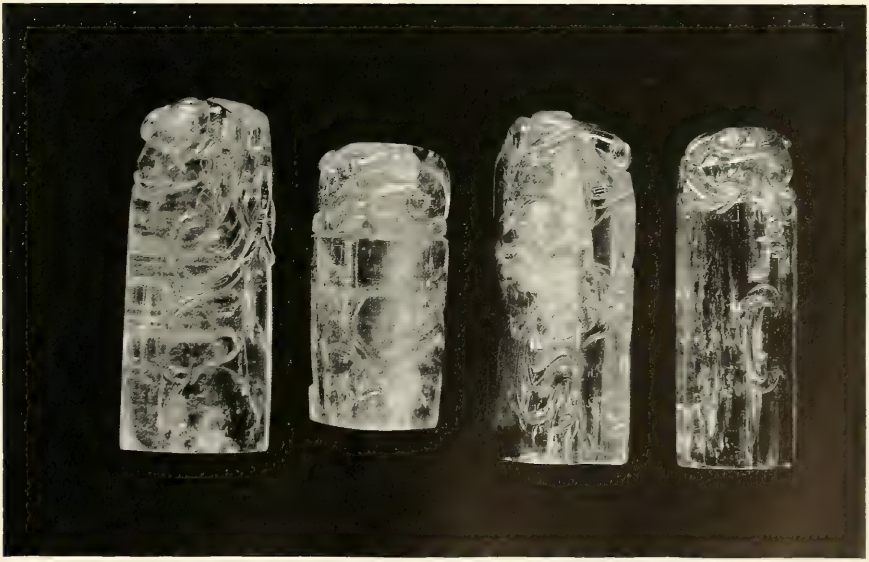
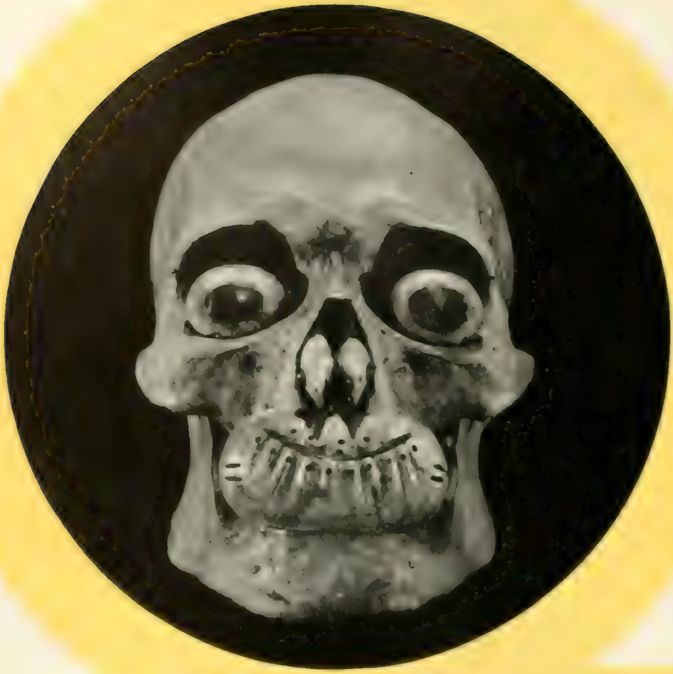
*See "Gem for February," by Frederick H. Pough, NATURAL HISTORY, February, 1941, p. 73.

Chinese seals carved from aquamarine, the alternative stone for March

All photos AMNH by Kirschner





MYSTERY PEOPLE OF THE ARCTIC

(Circle above) THE IVORY EYES of this skull from northwest Alaska look out across the centuries from an age when the glories of ancient Mexico were probably not yet born in human thought. With its inlaid pupils of jet, its ivory nose plugs, finely carved to represent birds' heads, and its ivory mouth cover, this guardian spirit of the buried city of Ipiutak left even the modern Eskimos speechless. The lip design suggests that the people may have had the idea of sewing the mouth shut to prevent the escape of the spirit

(Left) AN IVORY SEAL, carved by the "Mystery People." The size of their ancient settlement on Point Hope amazes modern investigators

Excavation of an "Arctic metropolis" on the ancient migration route from Asia to America reveals a previously unknown culture on the northern fringe of our continent, probably older than the Aztec and Maya civilizations

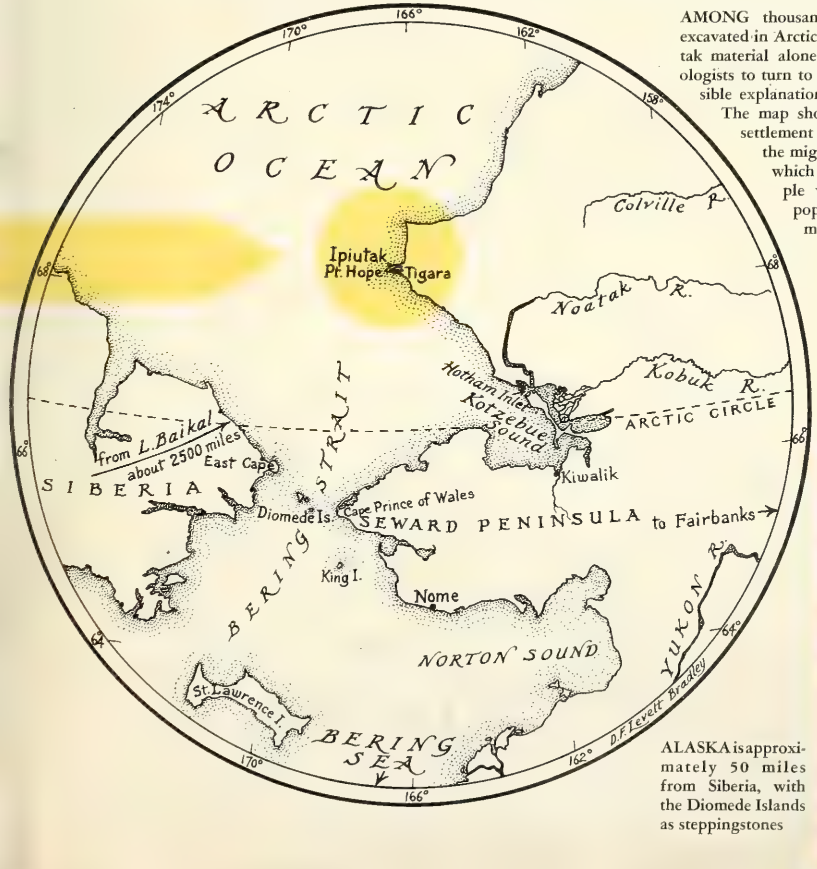
By FROELICH G. RAINEY

Professor of Anthropology, University of Alaska

MYSTERIES of all sorts have come out of the Arctic to stir the romantic interest of the civilized world—mysteries of lost expeditions and of lands that had been reported only to vanish. But the most fascinating mystery of all lies back of the people who live along this outermost edge of the habitable world.

The corner of Alaska nearest to Siberia is a key point in the search into the past, not only of the Arctic itself but of prehistoric America as a whole, because it is probably the region where primitive man first entered the Western Hemisphere. Today this "oldest" part of America is occupied by only a scattered population of Eskimos. Much digging has been done in prehistoric village sites, and the quantity of human relics unearthed is large. All of the material, however, has differed only in degree from the implements used by present-day Eskimos, with the single exception of the extraordinary discoveries I am going to describe. We have now found an "Arctic metropolis," many times larger than anything previously thought possible in this part of the world and inhabited by people whose material culture differed markedly from that of the Eskimos as we know them.

The discoveries which promise to tell the story of a new episode in man's history in the Arctic were found during the last two years at a point 200 miles north of Bering Strait. The ancient settlement is located upon a sand bar 20 miles from the mainland, where there is no fuel, not a single tree and hardly any vegetation of any kind, and where gales blow for weeks with the temperature at 30° below zero. Whereas settlements of no more than 250 Eskimos can barely find enough food to survive the winter in


166°
170°
162°
174°
158°
ARCTIC
OCEAN
Colville R.
Ipiutak
Pt. Hope
Tigara
68°
68°
Noatak R.
Hotham Inlet
Kotzebue Sound
Kobuk R.
ARCTIC CIRCLE
66°
66°
from L. Baikal
about 2500 miles
East Cape
SIBERIA
STRAIT
Kiwalik
Diomede Is.
Cape Prince of Wales
SEWARD PENINSULA
to Fairbanks
YUKON R.
King I.
Nome
BERING
NORTON SOUND
64°
64°
St. Lawrence I.
D.F. Levett Bradley
BERING SEA
170°
162°
166°

AMONG thousands of objects excavated in Arctic America, Ipiutak material alone forces archaeologists to turn to Asia for a possible explanation of its origin. The map shows the buried settlement just north of the migration route by which the Asiatic people who originally populated America may have crossed

ALASKA is approximately 50 miles from Siberia, with the Diomede Islands as steppingstones

A DOLL or fetish found among the ruins

[illegible] equipment.

[illegible] Yet the one implement upon which the inhabitants of this [illegible] The bones of the animals are there, but nothing that clearly explains how they were caught. The fantastic ivory carvings found in the houses and graves are unique. While the workmanship is by no means primitive, it must precede other known Eskimo cultures of the Arctic. Certain features suggest a connection between the style of this art and that of the earliest Eskimo cultures, but the ivory carvings and the [illegible] chipped flint implements suggest [illegible] between these people and eastern Asiatics.

How was it possible for such a large group of people to maintain themselves on the barren Arctic coast? Where did they come from and where did they go? Were they the ancestors of the Eskimos? These are a few of the questions we have attempted to answer since we and our Eskimo diggers uncovered this new riddle of the Arctic.

The story of how we found the ancient metropolis will give you some impression of the land as it is today. The Arctic explorer Knud Rasmussen had described the remains of a different settlement adjoining the Eskimo village of Tigara on the Point Hope sand spit as the largest ruin in the Arctic. In the spring of 1939 Helge Larsen, anthropologist at the Danish National Museum, joined forces with Louis Giddings and myself from the University of Alaska and the American Museum of Natural History to excavate that site. We arrived by airplane before the pack ice had retreated toward the north; and as we flew out along the Point Hope bar, the narrow ribbon of sand below us resembled a gigantic breakwater reaching out into the Arctic Ocean. The western extremity was a green spearhead thrust into the broken ice field.

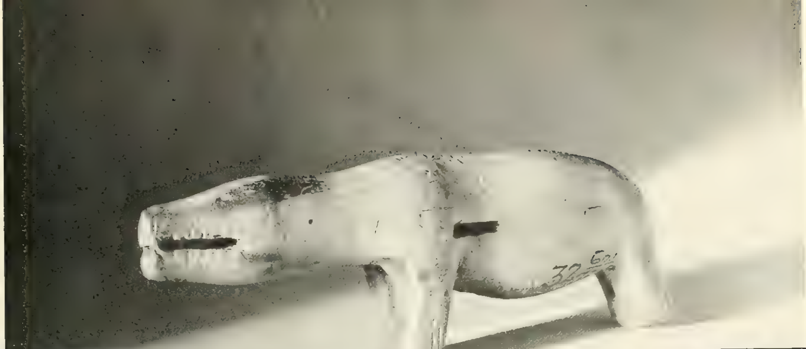
It was here that we found the Tigara Eskimos, popping up out of their semi-underground houses as we circled the village. From the air the present village seemed a continuation of the ruined village.

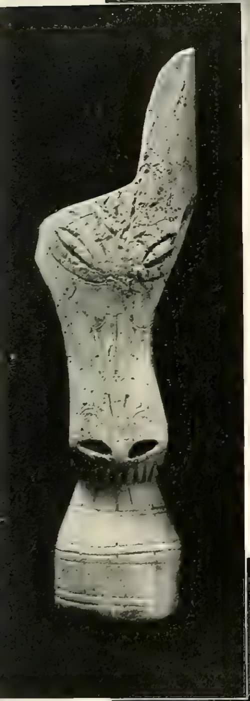
Our excavation disclosed that the site had undoubtedly been occupied for many centuries by Eskimos very much like the present inhabitants. The popularity of that spot is due largely to the fact that bowhead whales pass the point in the spring on their yearly migration north and east into the Arctic Ocean. These great baleen whales were and still are one of the chief food sources of the Eskimos, who not only store tons of whale meat in underground caches but use the baleen, or whalebone, and the bone as raw material for implements and utensils. The jawbones are even used for house beams and as markers in the [illegible] seals, bearded seals, walrus, and white whale (beluga) are also harpooned in considerable numbers, particularly in late spring. Before the domesticated reindeer was imported from Siberia, the Tigara settlement was abandoned each summer while families spread out in the highlands of the interior to hunt caribou, mainly for the skins, which were needed for winter clothing. Caribou meat, apparently, was never an important part of their diet, and even today reindeer meat is of little consequence. Literally millions of sea birds nest on the high rock cliffs of the mainland, where they and their eggs are taken for the summer food supply. But in spite of all this, the food resources of the region have never supported a settlement remotely approaching the size of the one we were about to discover.

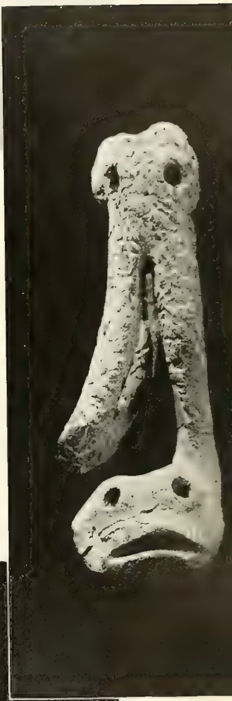
Eskimos living on about the same scale as the modern inhabitants can be assumed, on a basis of considerable excavation, to have dwelled in northern Alaska for perhaps 2000 years; and at the Tigara site we found nothing surprising. Farther east on the Point Hope bar we found other ruined settlements, but these also, although somewhat more ancient than the main one, contained implements of the familiar Eskimo type.

Then one evening Larsen and Giddings noticed some faint, rectangular impressions along the north shore of the bar, northeast of Tigara, at a place known to the Eskimos as "Ipiutak." Many years ago an Eskimo had found some stone and ivory implements at the site, but no one realized that the ruins of a large town lay underground. In the summer of 1939 we excavated a few houses here and found implements unlike anything we had seen, but even then the size and significance of the settlement were not anticipated.

One morning in June, 1940, when Magnus Marks and I returned to begin the second season of digging at Ipiutak, we became aware of the astonishing extent of the ruins—and through a peculiar circumstance. At that time of the year the grass and moss on the bar were just beginning to turn green. Owing possibly to the fertility action of the refuse beneath, the growth over the house ruins was slightly taller than on the surrounding plain, and consequently it retained the yellow cast of dead grass for a few days longer than that on most of the bar. Thus we could see long avenues of yellow squares, marking the house sites, extending east and west along the north shore. Within the next few days we hurriedly charted the location of the yellow squares and found that there



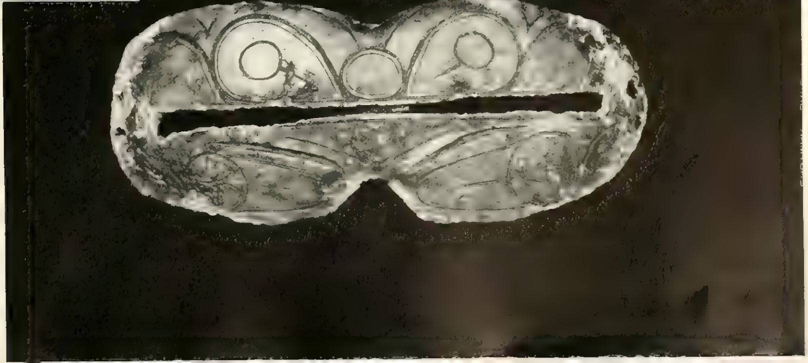


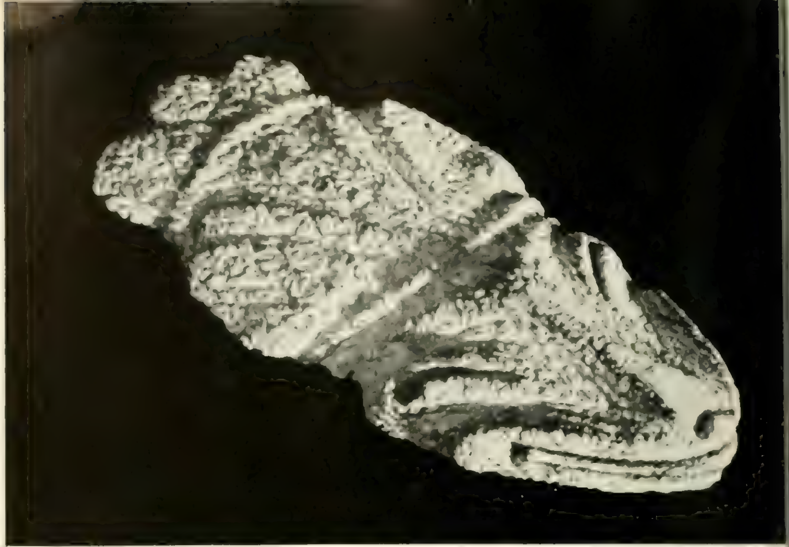


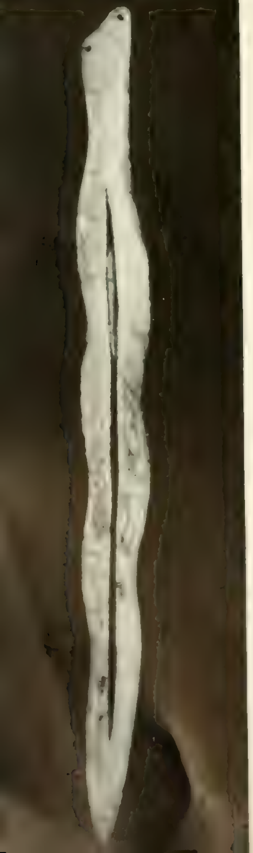
SOME objects left by the Ipiutak people do not differ markedly from recent Eskimo art, as is the case with the ivory bear above, of which comparable examples are found in various parts of Alaska

THE ARTICLES at left and right, however, are difficult to name and their utility remains a mystery. The likeness of an animal's head has been carved on each. The random lines marring the surface, particularly of the piece at right, are apparently the result of erosion by roots in contact with the ivory for centuries

SNOW GOGGLES to protect the eyes from snow blindness have been manufactured widely by the Eskimos for centuries, and the example below is more or less typical, except for the distinctive design cut on the surface. When worn in the dazzling sunlight, the slits effectively reduce the amount of light which reaches the eyes





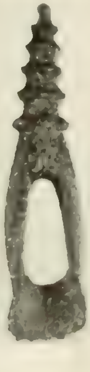


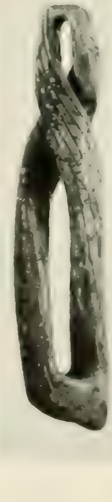
IN SIZE AND SHAPE the object at upper left is like a modern shoehorn. It may be a wrist-guard used to protect the wrist of an archer from the slap of the bowstring, but it only faintly resembles wrist-guards made by historic Eskimos. The ivory monster-like carving above has a perforated projection on the lower surface and must have been attached to some heavy object, perhaps a boat. Eskimos carve many Arctic animals such as seals, but this is not similar to any living form.

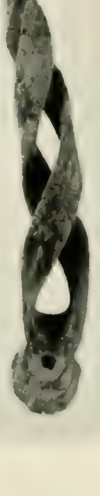
The object at extreme left shows how the Ipiutak people inserted wafer-like flint blades in their weapons. Only one blade of the original series remains in this lance head, near the upper end of the slot

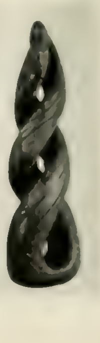
UNLIKE ANY ART PREVIOUSLY FOUND IN ARCTIC AMERICA

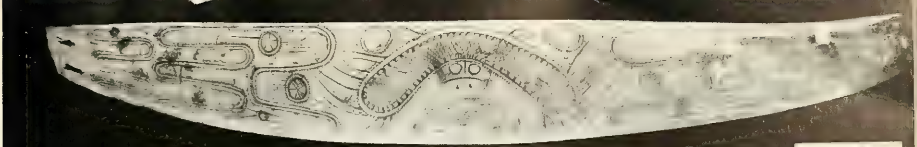
THIS peculiar double spiral motif, comparable only to certain art forms of the Ainus of Japan and the Amur tribes of northeastern Asia, suggests that the origin of the Ipiutak people may successfully be sought in Asia. The possible utility of the objects shown is not known but some resemble swivels perhaps used with dog harness







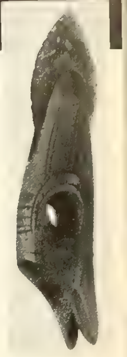


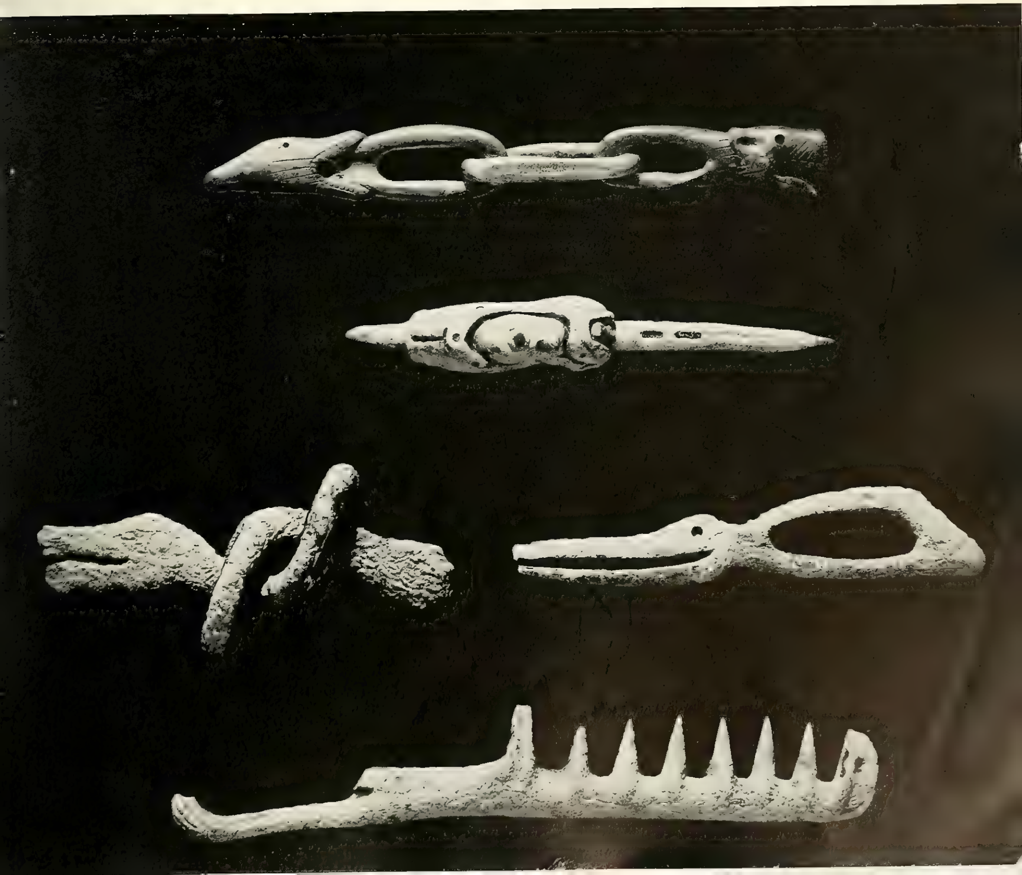


THE ELABORATE and sophisticated carving of the Ipiutak material indicates that the people of this Arctic metropolis may have been immigrants from some center of advanced culture. It also shows that, though their numbers were greater than had been supposed possible on this northern fringe of the habitable world, they had sufficient leisure for purely artistic activities

THE IVORY OBJECTS below show the bewildering variety of unidentifiable implements made by Ipiutak people and their remarkable ability in carving chain links, loops, and relief figures from solid blocks of walrus ivory. Inlaid jet eyes are typical. Heads of birds and polar bears are recognizable

HARPOON HEADS like the modern Eskimo's are rare at Ipiutak *(at right)*. The commonest weapon points are antler arrowheads with crescent-shaped flint blades set in the edges. Since Eskimos kill sea mammals with harpoons and not arrows, hunting methods of Ipiutak people must have been different





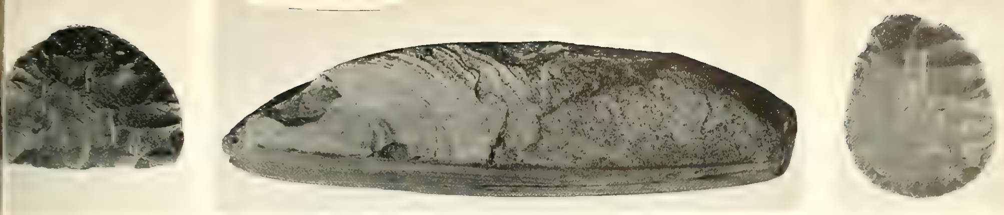
were just "avenues" [illegible] type houses as well as short [illegible] avenues crossed at right angles to the [illegible]. There were over 600 houses on the [illegible]. Later [illegible] test pits disclosed that there are probably 200 additional houses buried beneath so much sand from the beach that they cannot be detected on the surface. The town was nearly one mile long and a little less than a quarter of a mile wide.

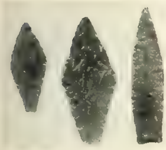
The arrangement of the houses, the similarity of the implements found in all 23 houses excavated, the fact that none were superimposed over older structures, and the absence of any large refuse deposits covering any of the village, lead us to believe that the majority of the houses were actually occupied at the same time. With an average of five persons to a house, the village would have a population of 4000, a seemingly incredible number of inhabitants for a hunting village on the Arctic coast.

The design of the houses is still a matter of doubt. We know that they were square and from four and a half to five and a half yards on a side and that they had a central hearth in which driftwood and blubber were burned in an open fire. Eskimos almost universally use a stone lamp for heat and light, but not a single lamp was found in the Ipiutak village. We also know that most of the houses had a long entry way facing west, that some driftwood logs and poles were used in construction, and that some had a plank or pole flooring about the central hearth. The walls and roof may have been made of driftwood or of sod blocks, moss, or skin placed over a wooden frame-

PLAN OF THE ARCTIC METROPOLIS. Today a village of 250 Eskimos is a large one on the Arctic coast of Alaska and often has difficulty securing enough food. The buried Arctic metropolis of Ipiutak was nearly a mile long and boasted five avenues aggregating at least 600 or 800 houses. The astonishing fact is revealed that at least 4000 persons must have occupied the village, a population which can scarcely be explained on the limited resources of the site as known today

AVE E
AVE D
AVE C
AVE B



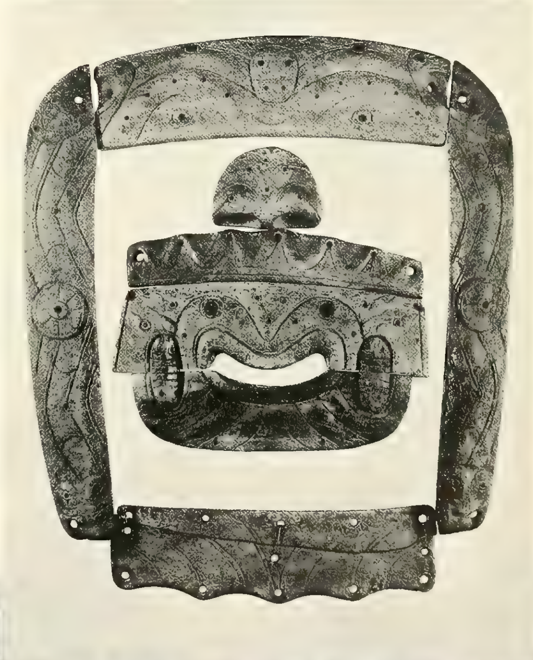


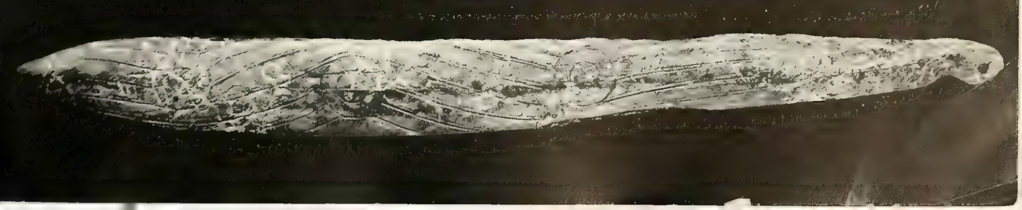
FLINT IMPLEMENTS found in the Ipiutak houses and graves number several hundred. Many are extremely small and beautifully made in a great variety of forms. Some were found set in arrowheads and knife handles but others are of unknown use. The Ipiutak flint working technique resembles that of early neolithic people in northeastern Asia and stands in sharp contrast to the cruder technique of the Eskimos. There are no rubbed slate blades but a few rubbed stone adz heads are present, which are not unlike those made by Indians

THE SET of massive ivory carvings below at right was found in graves which had been disturbed and partly destroyed by the burrowing of ground squirrels, and consequently the original arrangement of the parts is not certain. Presumably they were lashed in this form upon the cover of the log tomb or upon the breast of the body within. Jet eyes are inset, and a complex engraving covers the upper surface. Wheel-like figures and bands of parallel lines in part resemble incised figures made by the Old Bering Sea Eskimos, probably about the time of Christ

POSSIBLE LINK WITH EUROPE OR ASIA

THE IVORY OBJECT below may be a knife handle or a lance head. Along both edges are slots in which were set a series of small, crescent-shaped flint blades. Similar implements are characteristic of the Maglemosian epoch in northern Europe, and in the Eskimo region the technique of insetting a series of cutting blades has survived into recent times on Southampton Island in eastern Canada. Such implements in the collection suggest that the Ipiutak culture may be a connecting link both in time and space between Arctic culture of the Old World and the New

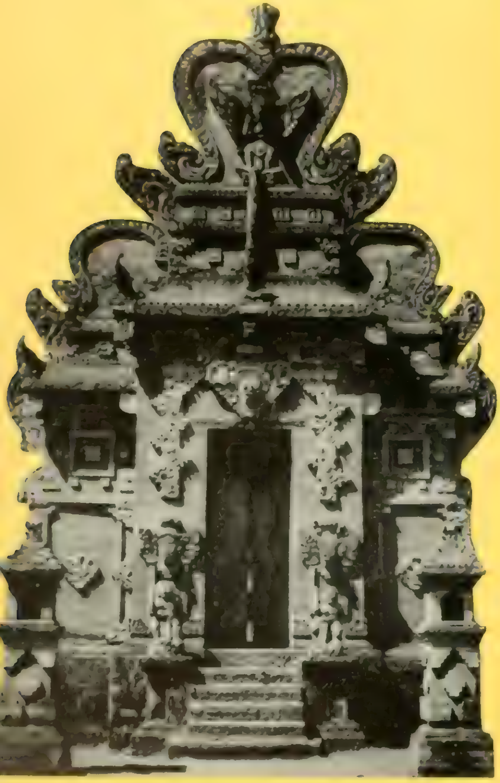




SOJOURN IN BALI

By Martin Birnbaum

In a region which may soon become a theater of war, the peaceful isle of romance still charms the world with its distinctive art, music and traditions



". . . Suddenly we turned a corner and were transported into an unbelievable world." This delicately carved doorway of a shrine standing in one of the three enclosures which constitute a "temple," illustrates the fine artistic sense of a native people who have made their island home a byword for beauty and romance

WASHED by a calm sea Bali's rich green mountainous slopes made an immediate and glamorous appeal, but the waterfront of the town of Boeleleng was painfully ugly. As we approached the wharf in a motorboat, superbly built bathers and fishermen smiled a pleasant welcome, and I discovered a group of half naked men playing games of chance on the smooth, black volcanic sand, ruled in squares to serve as a gaming board. Dirty looking betel chewing women walked up and down, carrying their possessions on their heads in old oil cans. K.P.M. agents, insistent guides, ubiquitous Chinamen, curio dealers, and greedy chauffeurs surrounded me.

My heart sank, and my spirit of romantic expectancy faded away. Disappointed but resigned, I placed myself in the care of a native driver, intending to cross the island at once to Den Pasar on the southerly coast, and I mentally decided to return quickly and catch the first available steamer for Java. I had obviously come too late to the isle of dreams which my friend, Maurice Sterne, the American painter, had visited and described to me over 20 years ago, but at least I would see a volcano or two before I sailed away with another dream shattered.

My refined chauffeur's name was Ngoman ("the third born") Gdé ("big") Mangkoe ("priest") Madé. When he was not driving a car, he acted as a provisional minor church attendant in his village or *desa,* and he took his young nephew along to assist him on our drive. Ngoman Gdé spoke and understood simple English phrases, and as we drove past commonplace villas with front garden patches like those I had seen in Java, I warned him not to stop to show me the cinema palace or the bank building. This admonition from his *toean* made him visibly more interested in my plans.

(Right) ONE of the largest arboreal wonders of the world: the banyan tree near Bongkasa, whose branches shade approximately two acres of ground. Many small temples and shrines have been built beneath this mysterious green mansion. It was under a similar tree that the altar described on the opposite page was erected, decorated with floating banners and approached by an avenue of ornamental streamers

He drove swiftly out of the town of Singaradja, away from the abodes of Dutch officials, into the heart of his island, refusing even to stop at interesting looking temples, politely explaining that they were unworthy of his employer's notice. Black pigs, resembling the Sumatra variety, with curved backs and bellies almost touching the ground, scooted out of our pathway, and venturesome hens and mangy mongrels barely escaped with their lives. Fighting cocks were secure in their bell-shaped baskets on either side of the road, and soon we were passing files of women walking like goddesses, carrying their burdens on their heads in the customary way. Men had their wares at the ends of flexible bamboo poles balanced on their shoulders. Both sexes were usually nude above the waist.

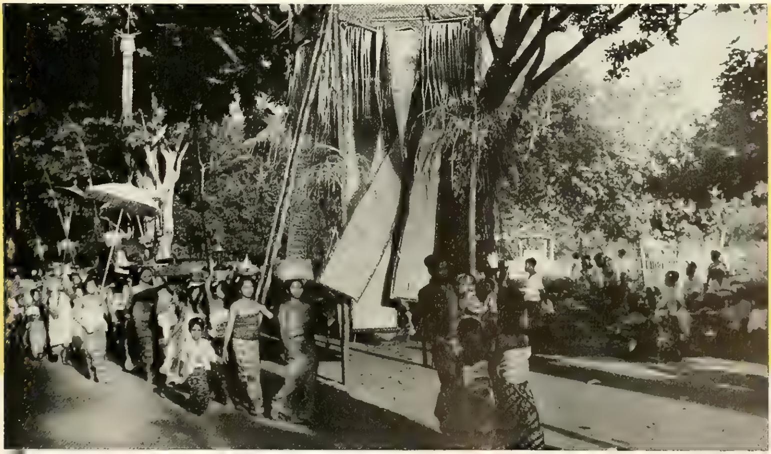
The villages along our route were surrounded by thatched walls, and the vegetation was like that of Java,—palms, bananas, crotons, thickets of bamboo, flaming cannas, many varieties of hibiscus, lantana blooming along the road with tropical negligence, frangipani, poinsettia, and vast rice *sawahs*. As we left the narrow northern plain along the coast for the hills, the landscape became more and more beautiful. The air was now refreshingly cold and bracing. We were climbing the foothills of Mount Batoer, one of the active volcanoes. Separated from us by *sawahs,* gorges, and fresh lava beds dating from a recent disastrous eruption, its smoking cone and black slopes suddenly burst into view at Kintamani, and the effect was startling.

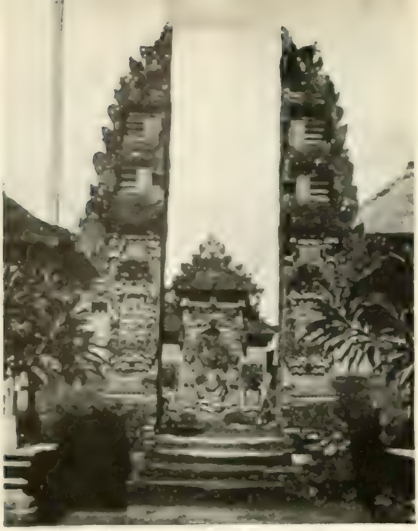
During the entire morning ride, I had been agreeably surprised to notice that only two automobiles with white men had passed us, and my hopes began to rise as we coasted south to Den Pasar, a distance of about 75 miles from Boeleleng. On arriving at the Bali Hotel, I was shown to my rooms—the usual comfortable Dutch colonial arrangement of bedroom, bath, and outdoor sitting room—, which faced a pleasant flower garden, where gray, rose-beaked Java sparrows flitted gaily about. Ngoman Gdé all but left the motor running while I was eating, and as soon as I stepped from the airy dining room he was at my side. It was the feast of Poernama—at the full of the moon—, and if the *toean* were not too fatigued after his ride, he had better go to the temple in the village.

We drove through Den Pasar's main business street, with its mean buildings, cheap curio dealers, laundries, Chinese and Japanese photographers, postcard vendors, and unattractive shops offering the worst European rubbish, and again I asked myself, "Why do I not make more careful inquiries and check my exultant fancy whenever I hear of some remote tropical region?" I might have sailed from Indo-China to revisit Samoa and Tahiti, where in spite of the Chinese and sordid white traders, beauty is still hidden in the distant valleys. Suddenly, we turned a corner, to gain the road leading to the temple gate,—and I was transported into an unbelievable world!

On this broad pathway, a high altar had been erected under a sacred banyan tree and decorated with floating banners known as *lamaks,* made of yellow areng palm leaves, on which a beautiful design had been interwoven with bright green leaves. Flexible bamboo poles, drooping with the weight of ornamental streamers, formed an avenue, down which visions of exotic beauty were marching toward the sacred portal. Along this highway an unbroken row of itinerant food vendors with small, portable kitchens were selling pawpaws, sugar cane, fried eels caught in the *sawahs,* raisins, peanuts, delicious mangosteens, pink grapefruit, white mango, and mysterious cooked dishes. They formed the background for the gorgeous parade of devotees, who came individually or in troops, often from distant villages. All carried offerings, usually arranged as pyramids of fruit or vegetables, exquisitely decorated with hibiscus, sweet-smelling frangipani, marigolds or other gay blossoms. How dignified these simple women were,

". . . Visions of exotic beauty were marching toward the sacred portal." Approaching the temple near the banyan at Den Pasar moved a gorgeous parade of devotees, worshippers of a living faith, carrying offerings of food and flowers for their gods. The floating banners are made of yellow areng palm leaves, beautifully interwoven with rich green leaf designs





THROUGH this characteristic cleft gate, or *tjandi bentar*, the procession marched, past the carved screen intended to hide the entrance from evil spirits. (Recent Balinese workmanship)

[illegible] offerings to their gods on their well poised heads! Frequently large groups would arrive, all [illegible] in green, yellow and brown and others in red, gold and purple, with flowers in their black, glossy hair or behind their enlarged ear lobes, in which gold plugs or cylinders shone. They moved placidly along, with proud bare breasts and bare feet, past the fierce-looking stone guardians (which today wore modest cotton aprons around their loins), to disappear between the curious parallel lines of an elaborately sculptured gateway, or *tjandi bentar*, into the first of the three courtyards in the temple grounds. Young bloods, their precious carved kris handles showing above their shoulders, carried narrow, flying banners attached to long poles.

As the day waned, other natives came bearing images, idols, and emblems under richly colored parasols, decorated bottles containing holy water, and huge wooden platters with skillfully arranged food offerings. Many were singing. Each small procession seemed lovelier than any before. Not one of the many altars was neglected, and an unholy trespasser like myself was awed by the simple sincerity of the worshippers.

Seated on a raised platform in one of the many covered pavilions in the last of the enclosures was a row of five solemn, long-haired Brahman priests, who made an imposing picture seen by dancing torchlight through the smoke of burning incense. Each wore a miter of crimson and gold, recited prayers, made mystic signs with their adroit, expressive hands, rang bells and accepted offerings for the great gods and lesser spirits. Nearby, little children squatted, listening intently to the *wayang kulit*, or shadow play, [illegible]

Nor were the evil spirits forgotten. To rid the grounds of them, the youthful banner bearers ran [illegible] a vigorous old man sprinkled them freely with holy water. Firecrackers were also exploded to frighten the demons away. Outside the main gateway enor- [illegible] Starving mongrels, prowling about, pounced without delay on these foul mounds of refuse, and amid snarls and savage growls, made short work of them.

Then night descended with tropical swiftness on this unbelievable scene. The haunting, laughing music [illegible] called the surging masses out into the already crowded road, where dancers entertained them, and I knew that I had fallen in love with Bali.

Ngoman Gdé divined my feelings and smiled discreetly. "*Toean* wish to see Sang Hyang?" he inquired. Naturally I was anxious to learn the meaning of those strange words, and off we drove. Apparently no "unclean" tourists had heard of this particular ceremony. All about us the frangipani was exhaling its incomparably delicious perfume. As we approached the temple precincts in pitch darkness, waves of sound reached my ears,—male voices yelling like American college boys: "Tsak, tsak, tsak, tsak." Then faster and faster in syncopated time, "Tsak-a-tsak, tsak, tsak-a-tsak," over and over again with many variations of tempo. I cautiously entered the enclosure to find the men squatting on the ground in a solid mass near a shrine. Two small girls, about ten or eleven years old, swathed in golden tissues, with lovely high crowns fashioned of mother-of-pearl and real flowers, were dancing before them. They were said to be in a trance, but this I could not confirm. Now gently swaying or running, now trembling with frenzied angular movements, or shaking their slender bodies like Egyptian stomach dancers, these two little virgins were, I believe, regarded as temporary embodiments of the spirits who were being worshipped. As my eyes became accustomed to the darkness, I saw that a group of women was seated some distance away. When the rugged, warlike song of the men ceased, these women began singing lyrical strains, and the character of the dance changed to female tenderness in graceful harmony with such hymns. On and on these frail but tireless children danced, without any visible sign of fatigue. When Ngoman Gdé whispered that the ceremony would not end till dawn, I left reluctantly, for I had discovered that Sterne's Bali was still in existence, and that there was to be no rest for me on this exciting island.

I had been told that to know Bali I must become acquainted with Walter Spies, who had settled in the distant village of Oeboed to make a thorough study of the *gamalang* and its music. Only natives are permitted to own land in Bali, and Spies had built an enchanting house on a leased tract at the edge of a picturesque ravine through which ran a stream. To reach it, I motored along an exceptionally beautiful road. When the aisles of banana trees and palm groves gave way to rice *sawahs*, I enjoyed views of Goenoeng Agoeng, or the Peak of Bali, rearing its great cone 10,000 feet into the air. Men and women, not always in separate groups, were washing themselves unashamed in the yellow creeks running along the road. Children were comparing their fighting crickets which were imprisoned in small bamboo cages. A goose boy, built like a young Hermes, controlled his snow-white charges with a flexible bamboo rod, to the end of which a few feathers had been loosely tied. Herdsmen in shaded pools were sprinkling their beautiful, soft-eyed, brown-and-white cattle, which were descended from an agile, wild variety. And everywhere—in the villages, in the rice fields, in the trunks of aged banyan trees, and in private houses—were temples and shrines. Obviously these people believed in the power of their gods.

I soon learned that Spies was not only an excellent musician but a good naturalist and a painter of remarkable pictures, which breathed the very spirit of Bali. His thatched house, built in part without nails like a finely constructed Fijian abode, was a storehouse of Balinese art. In the garden he had a veritable menagerie of pets, including monkeys, doves, cockatoos, dogs, and even a python. He had made careful piano transcriptions of the music of various *gamalangs,* arranged for eight hands. Admitting that he could not reproduce the peculiar booming quality of the deep, reverberating metal bells, or imitate successfully the gentle, liquid oboe note of the bamboo gongs, nevertheless, even on one piano, he played extracts that were very satisfying. He encouraged the native dancers and musicians to keep their traditions alive. For several years he had been carefully copying over 500 of the inexhaustible series of unique designs on the fragile, perishable *lamaks,* classifying them according to motif and place of origin. Whenever he found a hitherto undescribed spider, slug, or dragonfly, he made scientifically correct water color drawings of it. Sculptors, weavers, draftsmen, and carvers of bone found in him a ready purchaser of their best products, and with the Dutch artist Bonnet he was a leading spirit in building up the collection at the Den Pasar Museum, which is incidentally an excellent example of native architecture.

Spies was so pleased with my appreciation of his adopted island that he promised to unveil the real Bali to me. When night fell, we went to the village of Behdoeloe, where great crowds had collected in an open square to witness a dance called the "Katchak." This dance lasts about an hour and differs in certain ways from the more typically Balinese dances. Several hundred men, nude except for a loincloth, had already squatted down in a mass of uneven, concentric circles, around a carved, wooden candelabrum stuck into the ground. Its branches supported three flickering torches. From a distance, the glistening bodies looked like a great tropical blossom, blooming in the starry night. We, the spectators, stood like fascinated ghosts in the obscure world beyond this colossal flower. The *gamalang* had no place in the performance, but at a hidden signal given by one of the leaders or key men, a sharp, deafening cry arose. All the men were now alert, their shining bronze faces lighted by the dancing flames. As the action developed, they leaned forward, their nude torsos exuding male strength, and they uttered rhythmic, muffled cries, like sighs of infinite exhaustion, as though they were suffering from some hidden frustration. Then the volume of sound would increase and end in a great roar. The air vibrated with lusty cries. Bodies swayed, arms and hands were brought into play, and their thousands of fingers trembled like aspen leaves. Gaunt demons threatened them, and their despairing cries changed to a sharp staccato. The soloists representing

THE GAMALANG (native orchestra) weaves the melody while the well-known dancer, Goesti Ngoerah Regog, performs the Gong Kabiar, a dance which expresses the emotions of terror, coquettishness, and serene pleasure by deft motions and postures. The music suggests Bach, but the scale and intervals differ entirely from the European

[illegible] vanced and retreated but never broke. Realizing that [illegible] escaped into the dark jungles, followed by the shrieking men. The Katchak was over, the plaza in the village was empty—and you were left breathless and [illegible]

On the following evening when I rode back to Den Pasar, brilliant fireflies hovered like supernatural spirits over the *sawahs*. Answering the call of the *gamalang* on the roadway, I found that this time no public performance was in progress. Goesti Ngoerah Regog of the village of Tabanan, a well-known dancer, was merely giving a lesson to a little boy, who could already take the mime's part in the Gong Kabiar. In this dance the lone performer, holding a fan and wearing a long, trailing, silk sarong, is seated on the ground, surrounded by the orchestra. He expresses various emotions with his eyes, face, lips, fingers, and entire body, which sometimes moves swiftly from one point to another without showing the performer's feet, covered as they are by the long sarong. The music is an intricate web of themes and variations rarely containing a melody in our sense of the word, and with a scale and intervals differing entirely from the European kinds. Nevertheless the music suggests Bach. All the instruments are played by percussion. Although there is no conductor and no written music, the players, who depend like Hungarian gypsies solely on their memory, seem to keep a close watch on the principal *gangsa* (a kind of cymbalo performer).

While the men played, the clever, diminutive dancer suggested terror, joy, coquettishness, fury or serene pleasure. He was not unlike one of our own *Wunderkinder* who superficially imitate a Kreisler or a Pachmann, although with no profound passion.

When Goesti Ngoerah Regog was not satisfied [illegible] boy, held the child's flexible fingers between his own, and forced the little fellow again and again to execute the swift complicated patterns of hands, arms, and fingers, while the *gamalang* wove its frenzied measures. At first he seemed to be a capricious, elegant lover, but without any transition he changed into an impetuous warrior. Other children were looking on absorbed, and not infrequently the master would persuade one of these to try his skill. All the people enjoy such entertainments, which are like free communal festivals.

Almost invariably I was the first to leave the nocturnal meetings, for I knew that Ngoman Gdé expected me to start on the next excursion bright and early. One morning he took me to the fishing village opposite the island of Noesa, and we arrived in time to witness the blessing and consecration of a new house occupied by an interesting German family, who were expert herpetologists. Frau Neuhaus, not only created remarkable dolls but also assisted her two sons in making perfect replicas of reptiles and fish in various media. They had just completed a book on the poisonous reptiles of Java and Bali and were now building an aquarium close to the shore. The natives took an active interest in such work and brought many rare specimens to fill the tanks. Several hundred people came to the religious ceremony, bringing the usual offerings to an altar erected on the beach in front of the new dwelling. A long-haired *pemangkoe* officiated. As always, the dangerous, unfavorable spirits received their share of food and attention, and when the ritual came to an end, Balinese mongrels were there, ready to fight over every scrap of food left uneaten. Young Neuhaus informed me that these dogs performed a valuable service to the community. They were the island's chief scavengers. Rabies was unknown, and for that reason no dog, cat, or monkey was permitted to land in Bali. An English humane

RELIGIOUS IN ORIGIN, cockfighting persists against modern opposition. Almost every man brought a gamecock to the red and white striped tent below, and the crowd was democratic, but there were no women. The sportsmen make offerings at the altar of the God of Cockfights. Four-inch spurs of double-edged steel are fixed to the left leg of each fighter, bets are laid, and the struggle is usually short and swift

AN ISLAND TEMPLE situated in peaceful isolation just offshore near the village of Teglod. At low tide it can be reached on foot

society had mercifully killed about 70,000 incurably sick dogs, but many thousands were still left to do the work of vultures.

After we had finished drinking rice wine to the happiness of the household with the *pamangkoe* and *poengawa,* or district head, we all repaired to a neighboring field where a great cockfight had been arranged with the consent of the authorities. Unsuccessful efforts have been made to discourage the sport, which was religious in its origin and was once regarded as a blood offering to the gods. Ngoman Gdé enjoyed the excitement but he soon learned that his *toean* preferred to see dancing—the plastic expression of the spiritual life of the Balinese—, and we became familiar figures at such performances.

I have touched upon Balinese artistic activities in a separate essay,* and most of the dances have been described at length in the books of Spies and Covarrubias, published after my visit to Bali. It may be noted here, however, that with each type of dance or play, the instruments vary and also the music, which has the character of an improvisation closely following the action. It was always a pleasure to see the young artists, who are trained from earliest childhood, make up for these dances, painting additional hair on their brows, ornamenting their heads with fresh blossoms, fixing their glittering tiaras or powdering their bodies. When their toilets were finished, they invariably knelt before the altar in the temple grounds and were sprinkled with holy water before commencing their performance.

One is always missing something in Bali. While I was off in some distant village to see a dance, a tooth-filing ceremony, a six-month birthday celebration, or a wedding might be taking place at Den Pasar. So with my untiring guide, I would start out each morning for some unexpected artistic or romantic adventure. It might be a pilgrimage to the little temple built on a high, rocky islet off the shore at

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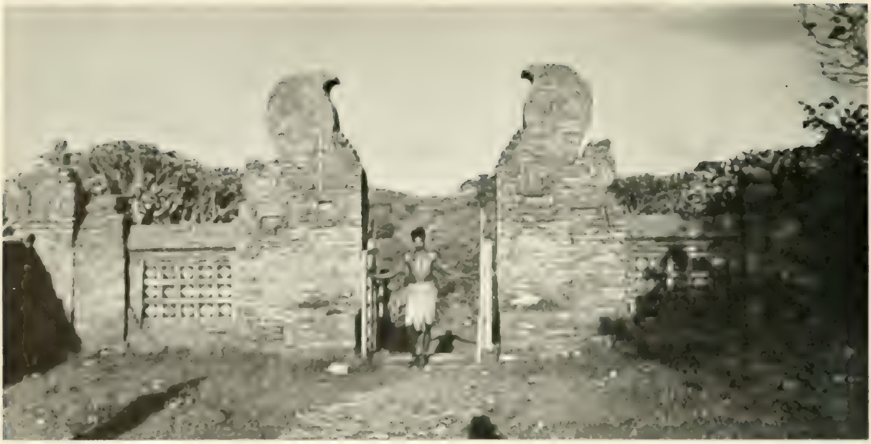
*See "Contemporary Art in Bali," by Martin Birnbaum, *Asia* Magazine, April, 1936.

THE REMOTE southerly cliffs of Bali, on which a unique *poera,* or temple, is built, are not often visited by many travelers. The gateways of its first and second enclosures are shown on the following pages



THE ENTRANCE to the first enclosure of the temple on the high cliffs of the southernmost shore of Bali: architecture of a style seen nowhere else on the island. It is difficult to determine the age of sculptures or buildings in Bali. The soft native stone cannot resist the wear and tear of time and moisture, and the natives are kept busy repairing deteriorating works

I [illegible] a visit to the most [illegible] temple on the high cliffs of the most southerly point of Bali, where the wall [illegible] and ornaments differ from all others I had seen.

Most enjoyable, however, were the walks I took in the company of Walter Spies. Together we went to the Hinduistic temple or cave of an ascetic, known as the "Goa Gadjah" (near Behdoeloe), over the entrance of which a fantastic evil genius had been carved from the living rock. Not far from it were the even more interesting primitive reliefs of Toya Poeloe, which will soon be obliterated unless something is done to protect them from the percolating waters of the [illegible] surrounding them. Spies was greatly concerned over their preservation and he showed me other sadly damaged relics at the highly venerated temple of Panalaran at Pedjeng, which was probably the old religious center of Bali.

There I tried to photograph the great sacred gong, said to have been an earplug of the moon from which it fell. My task proved almost impossible, for it was virtually hidden by a high, wooden scaffolding. It is decorated in a unique manner with human heads in very low relief, and although much larger than any gongs in the famous collection of the Musée Finot at Hanoï (Indo-China), this magnificent bronze shows certain similarities. With the ancient sculptured fragments of Brahma, Vishnu and Siva, which are crumbling to dust in other pavilions at this same temple, the gong ought to be taken to the Den Pasar Museum, but the religious Balinese will probably not permit such a sacrilegious removal.

After my secret photographic efforts we went to the celebrated royal tombs, hewn from the perpendicular rocks on either side of the Pekrisan River, near Tampaksiring. On these are inscriptions in the ancient language of the Kediri district, which have been deciphered but there still seems to be some doubt as to the identity and rank of the persons buried. On one side of the gorge there are five tombs, or *tjandis*, of a princely ruler and his wives; while the four tombs on the opposite side are said to contain the ashes of ministers. Nearby are many empty, rock-hewn cells formerly belonging to ascetics of a now deserted monastery. Offerings are still made on the ruined altars, and in the narrow corridors we surprised a number of pilgrims who were bearing the usual lovely gifts. At Tampaksiring itself there were more worshippers, who came to the sacred springs of Tirta Empoel to be purged of their sins. Here the water bubbles up through volcanic sand and is carried off into various basins. The original spring is reserved for the gods; while the other pools are for native men and native women, and one may even be used by foreigners.

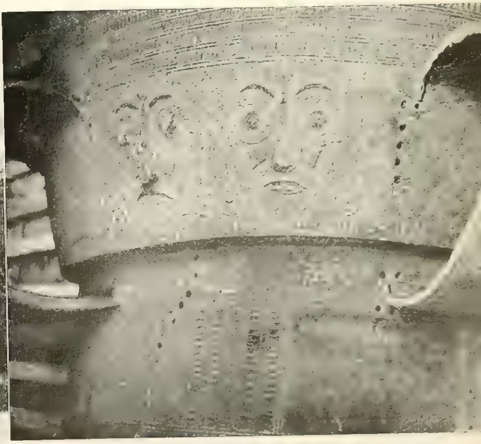
On one of our excursions we drove to Lake Bratan, at the foot of Mt. Tabanan; and at all the crossroads we passed statues of the God of Roads and his disciples. We even penetrated the mysterious jungle on the shore of the lake. The finger-like roots of the giant pandanus hung menacingly in the air above our heads, and the boy who carried the orchids we had collected was plainly anxious to leave this unholy, sunless wood. It was a passionately wild growth, with a few gaunt trees soaring above the common level. Creepers or clinging epiphytes struggled for life and air with magnificent abandon. While Spies told me of the glories of the unexplored forests covering the western half of the island, where the tiger still reigns supreme, we gathered armfuls of ground orchids, discovered monkeys, green doves and a *kapkap* (large squirrel), and studied the dazzling dragonflies and butterflies.

Spies told me that although March is not the sea-

THE UNIQUE ART of the builders of this *poera* is evident again in the reliefs of the second gateway to this southernmost temple of Bali. A view looking through the arch toward the outer entrance

(Lower left) CARVED from the living rock: a Hinduistic cave of an ascetic known as the "Goa Gadjah," near Behdoeloe. A rakshasa, or evil spirit, guards the entrance. Not far away are the equally interesting primitive reliefs depicting a hunting scene. These will soon be obliterated unless something is done to protect them from the percolating waters of the rice *sawahs*

(Below) A HUGE GONG at Pedjeng, the oldest religious center of Bali: a work of art probably never before photographed. Hidden by a high wooden scaffolding and regarded as extremely sacred, the gong presented problems not usually encountered in the photographing of native art. It is decorated in a unique way with human heads in low relief and borders of sawtooth pattern. The Balinese say this gong is a cylinder fallen from the ear lobe of the moon



(Above) ROYAL TOMBS carved in the rock near Tampaksiring. In the crypts the body of a prince and his wives are said to repose

(Above) A BIRD'S-EYE VIEW of the sacred springs of Tirta Empoel at Tampaksiring, where pilgrims come to bathe, to be purged of their sins

(Left) A HIGHLY VENERATED spot to which annual pilgrimages are made by all Balinese: a scene at Besakih. Here in the hills, at an altitude of about 3000 feet, a great number of pagoda-like *meroes*, the earthly abodes of deities, are standing at different levels on a series of terraces. The *meroe* of Siva the Destroyer, most powerful of all gods, has eleven stories

for the funeral ceremonies, some of the eastern villages might start building cremation towers by reason of the exceptional dry spell. Thus encouraged, Ngoman Gde began a search. At every village men were repairing the temples, or adding new sculptured figures to the portals. The character of the vegetation changed as we ascended the foothills of the majestic Peak of Bali, and the wide vistas became grander at every turn. At this altitude the people were actively engaged in farming and cattle-raising. Toward noon we reached Besakih, about 3000 feet above sea level, where we saw the celebrated and most sacred of all Balinese temples, built on a series of terraces. A steep stairway of 49 steps leads to the main gateway, and the superb wooden doorways are covered with decorations in relief. Each district has enclosures of its own, containing shrines and *meroes* to which annual pilgrimages are made. As all are built on different levels, the effect is very impressive. A long-haired priest and his manly young son showed us about and presented us with live poultry and oranges from their orchard.

In the course of this long search for a funeral, we wandered about the villages, ventured into hospitable private homes, and witnessed many phases of Balinese life new to me. We watched the women weave their many-colored sarongs with borders of silver and gold threads, and saw the sculptors carving the soft native stone into gods, with no models or designs to guide them. A boy would be drawing a jungle in which fierce tigers prowled and poisonous-looking flowers bloomed, while his father was carving the head of a deer, into which he inserted genuine antlers. The trembling hands of a very old man were still fashioning Garudas and kris handles, and attentive pupils were always studying the progress of such work.

In preparation for the Dutch Governor General's visit, stalwart workers paid their taxes by repairing the road down which farmers were carrying golden sheaves of rice that swished at the ends of bamboo poles. Temples, literally by the thousand,—to the gods of mountains, rivers, rice fields, roads, trees, and to Baroena, Lord of the Sea—were built everywhere and the variety and originality of the decorators' art was never exhausted.

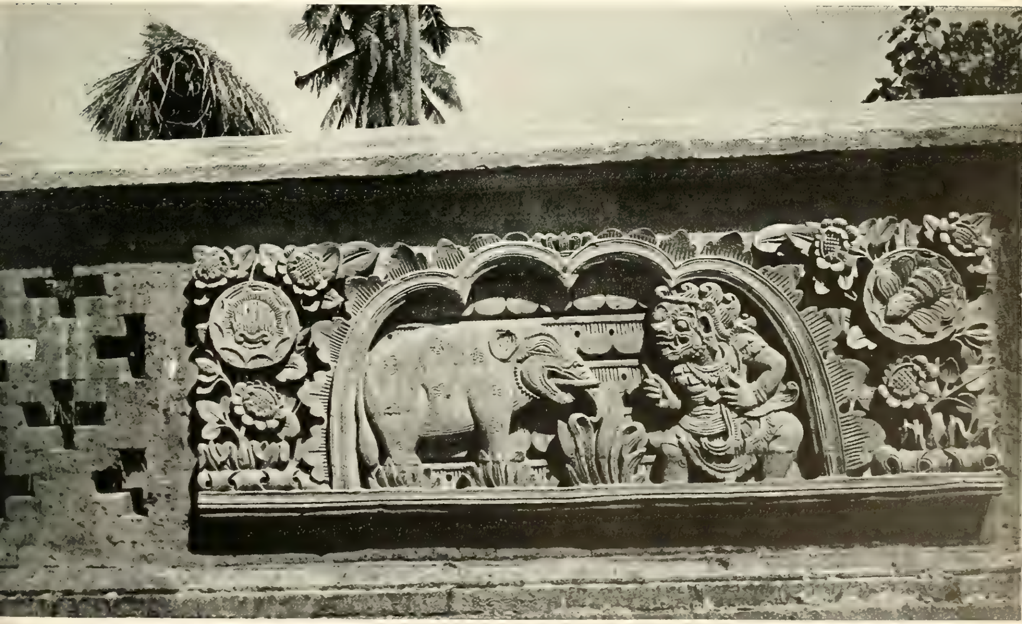
Apes are often seen on the reliefs, and in the holy grove of nutmeg trees at Sangeh, troops of impertinent, sacred monkeys are always waiting to be fed by visitors. The leader was ravenous when we arrived there and forced my hand open till he had devoured every available grain of corn. None of his wives, children, or rivals dared to approach till his greed was satisfied, but unexpectedly a beautiful, harmless striped snake fell from a tree, and there was a wild scattering and chattering.

In the grove, tall pala trees that no one may fell, rise to uniform heights, and the winged nuts are gathered by the natives, who use the powder to keep their bodies cool. When I left the grove I came upon a young girl who held a long, swaying stick in her hand (probably the central vein of a nipa palm leaf), at the end of which were a few spikes on which the sticky juice of the nangka or jack fruit had been smeared. Dragonflies settling on it were immediately caught and gathered in an apron, to be roasted in oil and eaten. Wafers of toasted bees are another delicacy and reminded me of the African termite feasts and the locust eaters of the African desert.

Not far from Sangeh on the outskirts of the village of Bongkasa, Ngoman Gdé insisted on making another detour, for he wanted me to see a banyan, which is not only one of the largest but also one of the most beautiful, natural arboreal wonders of the world. Over 10,000 square yards are shaded by this superb tree, and hundreds of new aerial trunks are adding annually to its unbelievable grandeur. It was under such a tree that the Buddha meditated on the sufferings of humanity, and one might well be inspired to find truth in this mysterious green mansion. Many temples and shrines have been built under its boughs.

At last, when we had almost given up hope of attending a funeral, Ngoman Gdé came in great excitement to tell of a double cremation which would take place at a village on the southeastern coast, beyond Kloengkoeng. Naturally we took the shortest road. Upon our arrival I was at once surprised to find no visible signs of grief. On the contrary, a gay, festive air reigned, and the bereaved families and relatives invited us into their houses, where they laughed and chatted around the bodies of the deceased. Had they shown sorrow, the spirits of the dead would linger in the neighborhood, instead of going on their allotted way to the region of the blessed. A very old man had died, and the bodies of several younger members of his family, who had long predeceased him, could now be prepared, ceremonially, and all were to be burned together. It would be indelicate for young spirits in a family to start their heavenly journey before the older members were ready to depart. In this village the bereaved families were not very rich, and the two *wadahs* decorated with colored tissue paper, tinsel, and streamers, although very gay, were not comparable to the magnificent casket towers prepared for the bodies of nobles. While old women were preparing food and offerings, the *gamalang* was playing for the crowd and did not stop till the men shouldered their instruments to take them to the cemetery. Then about a hundred men wearing only loincloths prepared to remove the eight or ten bodies, which had been wrapped in a series of plaited mats, to the topmost stories of the towers by means of inclined planes. There were Polynesian, Malay,

This carved stone panel of a temple wall is an example of contemporary Balinese sculpture and testifies to the present-day vitality of native craftsmanship. There are no Balinese words for "art" and "artist," and no one asks the name of the creator of a sculpture or drawing. In Bali, life itself is a communal artistic festival



Papuan, and even Chinese types among these natives.

Amid loud shouting and frenzied excitement they seized the bamboo platforms on which the two towers rested and started down the road followed by the populace. The women sprinkled holy water on them, and boys who clung to the towers threw Chinese cash into the scrambling crowd. The carriers made very slow progress. To confuse evil spirits they moved in an uneven line, repeatedly circling about, and there was always danger that the swaying towers with their ghastly burdens would topple over. It had been raining the previous night, and the road leading to the beach was converted into a sluggish stream of deep, almost impassable mud; but nothing could stop these men. Through the black morass they waded. We went by a roundabout way along the raised boundaries of the *sawahs* to the cremation field adjoining the sea. When we reached the shore the nude porters were already up to their heads in the breakers, taking a short cut through the water to the meadow on the other side of the bay, where the bodies were to be burned. As the current was swift, the men had great difficulty in supporting the swaying *wádahs,* but the danger only added to their gaiety, and when they had successfully avoided disaster and landed the towers on the sands, they all rushed back noisily into the sea for a swim, before the gruesome business of the day was begun.

Wooden funeral pyres were constructed, each with partitions for the bodies. The mats were unfolded, and the decayed cadavers or what was left of them, were washed with holy water brought in pots by friends and relatives of the deceased. A long piece of cheesecloth was held over each body, holy water

(*Left*) AN AVENUE of decorative figures leads to a temple in the hallowed grove at Sangeh, inhabited by a tribe of sacred monkeys. This sculpture is of recent origin, though the green moss which soon covers the stone gives an appearance of great age

(*Above*) The old Water Palace at Kloengkoeng, which lay on the author's route to the scene of the remarkable cremation ceremony depicted below. The famous Hall of Justice, with its celebrated painted ceiling, is nearby

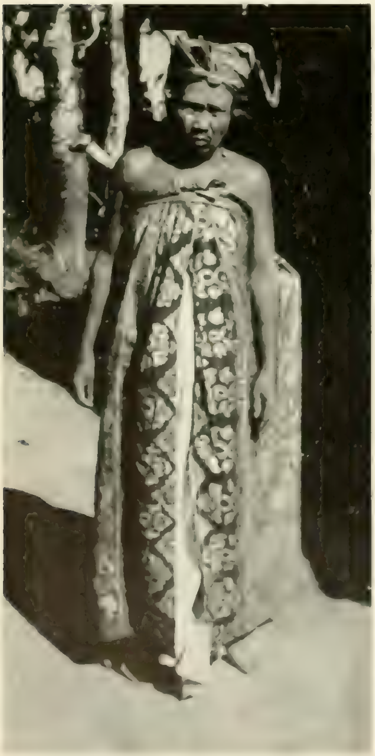
(*Above*) A FESTIVE spirit prevails at Balinese funerals, otherwise the spirits of the dead might linger and torment the living. The men are preparing to carry the funeral towers to the cremation field near the sea. This was the funeral of a small group of deceased Balinese, not aristocrats

THE *GAMALANG (left)* played for the light-hearted crowd until the funeral towers were carried away on the shoulders of 100 men. To confuse the evil spirits, the procession followed a winding route to where the ashes were consigned to the waves

[illegible] ware after its contents were strewn upon the re- [illegible] the entire mound was covered with inflammable twigs and set ablaze.

Thick wreaths of smoke arose, and all the people settled down to wait for night to fall. The ashes would be returned to the towers and then cast into the boundless ocean. If any part of a body remained intact, the departed could not continue on his or her celestial journey but would haunt his native town. Nyoman Gde advised me not to wait for the very end of the picturesque ritual because a kris dance would take place at twilight in Den Pasar, and I did not regret leaving the scene.

The strange, symbolic performance that I was now about to witness, will ever remain inexplicable to me. In a shaded glade crowded with natives near the temple of Den Pasar, umbrellas and streamers had been stuck into the ground, indicating that the region [illegible] coronets danced stately measures, and virtue reigned supreme. Soon, however, black demons, representing the deadly sins, mingled with them. The age of [illegible] came to an end and the triumph of vice was celebrated by a horrible Rangda with fangs and a long, forked tongue, who pranced about gleefully with a kindred evil spirit. Then a mystic lion or Barong appeared on the scene to struggle with the dread demons, but he was unable to vanquish them and retired from the unequal struggle. Meanwhile I had noticed a group of powerful, wiry men and adolescents, squatting at one end of the long open space formed by the audience. They worked themselves into a trance and began to stare like wild men at the monstrous witch. Foaming at the mouth, trembling and possessed, weeping hysterically or making strange uncontrollable "epileptic" movements, they seized their krisses, arose in a body and rushed at the destroyer. The Rangda held her ground, and the fanatical horde, in danger of being embraced by those devastating claws, retreated. When she attempted to run away, however, they gathered courage and followed. Up and down the glade they ran, pursuers and pursued, until she escaped. The



(Left) THE DAG, or teacher, who takes part in the dances. The Balinese dance is a vital and spontaneous phase of life on the island, and there is no immediate danger that the dramatic traditions will be forgotten. All the people enjoy the entertainments, which are like free communual festivals. Frequently a local ruler will arrange a performance at his own expense

(Right) THIS PLAY is based on a story in the Mahabharata. The prince Arjuna, a male role allotted to a well-known actress, overcomes a demon who assumes the shape of a monstrous bird. The hero's attendant on the right is the veteran actor shown in the photograph at left

tension never relaxed, and now a really terrifying scene ensued. In their disappointed fury, these *permadis* turned the sharp krisses on themselves and attempted with all their maddened might to pass the curved blades through their chests and abdomens, but the gods did not permit such sacrifices. Try as they might to pierce themselves and force the weapons between their ribs, some strange hypnotic power prevailed, and they never succeeded. They writhed in agony and ran amuck in the surrounding crowd, which scattered and fled. Finally some picked strong men rushed forward and forced the fellows to give up their weapons. Ready to faint with exhaustion, they stood for a moment as if drained of all strength, but in front of them stood the benevolent Barong, and as each pale man, physically and spiritually tired, saw him in turn, he embraced the weird mask and buried his perspiring head in its mane. Only then was he again transformed into a frail, normal, suffering mortal. I was told that frequently serious wounds were inflicted on the spectators by the irresponsible dancers, and I can well believe this. No one has as yet satisfactorily explained to me why these men and boys were rarely even bruised by those sharp, pointed krisses.

Excited and mystified by such incredible ceremonies, I left Bali before the spell was in danger of being broken. Already an erstwhile princess who refused to sacrifice herself on her husband's funeral pyre was persistently trying to sell me cheap tourists' trinkets. Other importunate, rascally natives were asking fees for showing salacious reliefs on the walls of a temple. Are these the descendants of heroes who committed suicide by thousands rather than submit to white domination? Is it possible that all the beauty I had enjoyed would become a mere legend and a memory? The more I scratched the surface of Balinese life, the more clearly I realized that my allotted time would prove all too short. Moreover, without the expert and kindly advice of Spies, my visit would have been an even more confused experience. So I left for Java while the unforgettable island still exercised its powerful fascination. Although a mist enveloped the coast, volcanoes showed their cones above the clouds, and a sunset lighted the clearing sky with an orange flare, only to disappear again as if by magic, leaving me in a twilight which filled the world with sadness. Then night became a fathomless flood of blue, sprinkled with golden stars, and Bali melted in darkness.

[illegible] may have been two feet below the surrounding sur- [illegible] a number of years, since there are rich deposits of [illegible] beneath a thick compact layer of sod and turf.

After a tedious search we found the cemetery of the Ipiutaks. No signs of the burials were noticeable on the surface; they were found only by excavating innumerable test pits over an area one and one-half miles long and a quarter of a mile wide. Apparently the finest and most prized possessions of the Ipiutak people were buried with them, since in the graves we found much more elaborate material than in the houses. Well-preserved burials were rectangular, log-walled tombs containing one, two, or three skeletons with their implements for use in the after world. The driftwood logs used in constructing the tombs had become a soft, fibrous mass, in which the skeletons were often completely imbedded, but the original rectangular structure could still be recognized.

Of the more than 60 graves discovered, the most exciting, particularly to our Eskimo workmen, were those in which the skulls were equipped with large, ivory eyeballs, inset with jet pupils. There were three of these, and one was also equipped with a carved ivory cover for the teeth, as well as two ivory nose plugs carved to represent birds' heads. The original eyeballs had apparently been gouged from the skull of the corpse, then replaced by the artificial ivory eyes. The bones of the skeleton were still in place, proving that these were not second burials of skeletons interred after the flesh had been removed.

One of the oddest burials I have ever seen was that containing a large male skeleton. Between the thighbones of this skeleton lay the tiny skeleton of a very small child. And thrust through the body of the adult, along the spinal column, was an ivory back-scratcher, carved at the end to represent a human hand. Most of the bones of this skeleton were still joined, but it was obvious that the body was at least partly dismembered before burial. Over it lay five long tubes carved from caribou antler; and under the pelvic bone lay a carved ivory chain attached to carved figures resembling polar bear heads. At the knee was the skull of a loon, with ivory eyes like those in some of the human skulls.

Some of the tombs contained arrowheads, flint tools, needles, and other recognizable implements, but most of the many hundreds of objects found in [illegible]. Many are elaborate ivory carvings often cut in a curious spiral form, which the Eskimos began to refer to as *nukpori*, their word for a pretzel-like biscuit made of flour paste and fried in seal oil. Very few of the objects were known to the Eskimos, who were as puzzled by the vast, ruined settlement, the graves, and the curious implements, [illegible].

Speculation and excitement in the village increased as more graves and more elaborate ivory objects were found. The wonder of the older people was expressed in the common statement, "But there is no story for this!" Their own history and the nature of the world in general is always explained in legends, which have been passed on from one generation to the next; and in any unusual situation, the old people are called upon for the "story," which will explain everything and at the same time determine what to do about it. The best contribution that the old people could make was to recall that parents a long time ago warned their children not to stay out late at night because they might meet a man with ivory eyes.

We, as archaeologists, have a difficult problem to explain the Ipiutak culture. We know from the bone refuse that these people were meat-eaters, dependent largely upon seals, walrus, and caribou. But they were apparently unfamiliar with the majority of well-known Eskimo implements. They had learned to make the toggle-headed harpoon, but from the relatively few examples found we can hardly believe that they depended to any great extent upon this important implement. In place of the commoner tools, they had a large number of peculiar implements, often finer and more delicately made than those of the present natives. There are no remains of sleds or boots, no rubbed slate tools so typical of all Eskimos, no pottery, no seal-oil lamps, and little of the gear used by Eskimos in hunting on the pack ice or in boats in open water.

We conclude that, although they lived in an environment not unlike that of the present Eskimos and hunted the same animals, except for the bowhead whale, the Ipiutak people had not developed or adopted Eskimo material culture as we know it. How then can one explain so large a population dependent upon animals for food?

Size of settlement

There is one possible explanation. When Kotzebue, Beechey, and other explorers first investigated the Arctic Ocean north of Bering Strait, they found a temporary summer settlement of Eskimos at the head of Kotzebue Sound, estimated to number at least 1000 persons. In summer these Eskimos came down the great rivers of northwestern Alaska to trade with each other and with people from Bering Strait. During the early summer they lived by taking large numbers of belugas, or white whales, in the shallow entrance of Hotham Inlet; and later in the summer they were able to net quantities of salmon. In the fall they went back up the river to fish and to hunt caribou in the interior. It may be possible that Ipiutak represents a similar seasonal concentration of people. Under present conditions they could not take belugas or salmon in sufficient numbers to support so large a population. But it is possible that walrus once "hauled up" in great numbers on the Point Hope bar to rest or breed, or that many seals could be taken there as the pack ice moved north. The Eskimos at Hotham Inlet lived in tents, and no large group of house ruins can be found there. If the Ipiutak settlement can be explained as similar, the people must have returned annually to permanent houses occupied year after year.

Again we must ask, who were these people and where did they come from? Comparing Ipiutak styles of engraving with those prevailing at other prehistoric sites in the Arctic, we recognize at least some resemblance to the work of ancient Eskimo people of northern Bering Sea. This clue is significant, because an unmistakable similarity in art work implies a definite connection, which in this case would seem to be with the most ancient Eskimos of the western Arctic, the so-called "Old Bering Sea Eskimos." But the latter possessed a material culture not very different on the whole from that of the historic Eskimos, while the Ipiutak culture departs so widely from this basic and ancient pattern that there is little real connection other than in the art style.

At least two explanations are possible. Either the Ipiutak people lived before the typical Eskimo culture developed in what is now Alaska or they were a foreign group who entered the Arctic from the south during an early period. If they came sometime during the many centuries since Eskimo people have lived there, they obviously took over only a small part of the Eskimo material culture and in turn had little effect upon the Eskimos. It seems hardly plausible that so large a group in a sparsely settled area could have had so little relation with neighboring people. It is more probable that the settlement of Ipiutak was occupied before other known settlements in Alaska.

Links with Asia

One of the most striking features of the Ipiutak material is the elaborate and sophisticated carving and the beautiful workmanship, which would not be expected in a primitive, proto-Eskimo culture ancestral to the modern. This suggests that the people of this Arctic metropolis brought their arts from some center of cultural advance and that they were immigrants from some southern region where their forebears had a well-developed Neolithic or New Stone Age culture adapted to the hunting of both land and sea mammals. Higher centers of primitive culture lie closer to the Arctic coast in eastern Asia than they do in America. Therefore it is toward Asia that we turn in our search for the origin of the Ipiutak people. A peculiar motif in their carved objects, which has not been uncovered anywhere else in America, is a spiral made of two elements carved in the round, as illustrated on page 152. Such a motif does occur, in relief, on carvings of the historic Ainu people of Japan and among the Amur River tribes of northeastern Asia. Furthermore, the exceptionally fine flint tools of Ipiutak appear to be more closely related to Neolithic flint work in northeastern Asia than to the coarser work of northern North America.

These somewhat intangible clues allow us to piece together tentatively a probable story. A Neolithic people of eastern Asia moved northward along the Asiatic coast, crossed over to the American shores, perhaps at Bering Strait, and settled the American Arctic coast at least as far north as Point Hope. This was during some period before the coming of the Old Bering Sea Eskimos, in terms of our own calendar probably before the birth of Christ. Apparently the people did not spread along the American coast but remained together in a single colony, since among all the thousands of implements dug up from sources of ancient sites along this coast there are no examples of Ipiutak culture. Archaeologists will, of course, be on the lookout for them.

We have yet to explain the gap between the Ipiutak culture and that of the most ancient Eskimos. Will other linking sites be found, or will this settlement remain as the only trace left on the face of the earth by this mysterious people? This can be answered only through further exploration, both in the inland regions of northwest Alaska and in that vast area of eastern Asia north of the Amur River and east of Lake Baikal, where unfortunately little is shown of the early history of Arctic penetration.

Fifty skeletons from Ipiutak, now under study, will reveal whether these people were related physically to the Eskimos and whether they were by any chance the ancestors of the present people of Tigara.

The Way of a Fossil Hunter

A veteran of twenty-eight expeditions, Walter Granger has served the American Museum at home and abroad for more than half a century. His picturesque rise from country boy to a scientist of international fame lends color to an expanding era

By D. R. Barton

ON A DARK NIGHT in the spring of 1922 Walter Granger was the only "foreign devil" inhabiting an obscure little village in the interior of China called Yen Ching Kou. His residence was a temple of the Buddhist type—the most imposing edifice in town—for which he paid the fabulous rent of $1.50 a month, his landlords being the T'ans, a local family whose members had erected the temple as a dwelling place for the shades of their ancestors. On this particular night a certain Chinese army was passing through Yen Ching Kou in full retreat, and another army, also Chinese, was expected to arrive on the morrow in full pursuit.

Granger looked down from the temple gallery on the curious sight of shadowy semi-uniformed troops slopping along barefoot in the mud while their matériel was being transported by miserable coolies, whom they drove along at bayonet point. The soldiers carried paper umbrellas — often a standard piece of military equipment in China—, but Granger was well aware that they were on the lookout for more substantial shelter against the threatening rain. And he knew that his temple was the most tempting billeting prospect in the neighborhood. The banners of the United States of America and of the American Museum of Natural History hung over the main entrance, but in such circumstances Granger had reason to doubt the efficiency of these symbols. Accordingly, he put his trust in the resourcefulness of his assistant, Jim Wang.

Jim, a remarkable Chinaman, had prepped at Highland Military Academy in Worcester, Massachusetts, and though it cannot be recorded that he went on to Harvard, he was certainly well equipped to serve as Granger's official interpreter. The situation, however, frequently proved beyond the scope of linguistics, and Jim based his strategy on the fact that foreign devils were at that time still held in considerable awe. Each time the short-tempered, footsore troopers battered their rifle butts against the door, Jim would summon Granger, open the door a little way, and subject his master to the full glare of a flashlight. Behold the foreign devil in the flesh! The soldiers reluctantly sought quarters elsewhere.

WALTER GRANGER

It was necessary for Granger to display himself thus several times during the evening despite a heartfelt preference for the shrouded seclusion within, among the departed spirits of the T'an family. Moreover, he had to spend most of the succeeding days on the temple doorstep advertising his presence to the pursuing army. There was no flashlight this time, but it was still a very trying experience. Not that Doctor Granger is a timid man. Far from it. But he is a master of self-effacement and nothing is more repugnant to his nature than to be spotlighted for public exhibition. In fact, he would never again consent to so protracted an exposure to the limelight save in some equally dire emergency.

It is just possible that his attitude toward illumination was acquired in uptown New York some 30-odd years before when duty obliged him to clean a series of kerosene street lamps in the dead of winter. These lamps were mounted along a boardwalk leading from the steam-driven elevated trains of that era to the single building which then sheltered the exhibition halls of the American Museum. To polish globes and trim wicks was a strange undertaking for a boy who later became the first paleontologist to enter the last great unknown fossil area in the world and wrest tons of scientific treasures from its ancient sediments. Yet though he is now one of the most renowned collectors of our time, responsible in whole or in part for a vast array of specimens ranging from a 66-foot Brontosaurus to Ectoconus, a 30-inch product of the very earliest age of mammals, he can recall no ordeal more arduous than this humble job of lamp-cleaning.

Early days

On the thirtieth day of September in the year 1890, a telegram was delivered to the Granger homestead in Rutland, Vermont. It was an important message from father to son, stating that, if he so desired, young Walter could find employment next day at the American Museum of Natural History in New York. Mrs. Granger promptly hitched up the team and drove out to the farm where her son was working and where he had spent much of his childhood. He was then approaching his eighteenth birthday. That night he boarded the New York train and at 9:00 the next morning first laid eyes on the institution he has since served with unusual distinction for more than 50 years.

Walter had long been interested in museum work, and his father, an insurance representative, had happened to drop in on Mr. Jenness Richardson, a former Rutland boy, who was chief taxidermist at the Museum and who informed him of the vacancy.

Of course, Walter was thoroughly familiar with the birds and mammals of his native Vermont and, like most rural boys of those days, he was accustomed to the uses of rod and gun. But he had to start from scratch in the taxidermy business, as he knew next to nothing about the preservation of specimens. Indeed, he had to start from less than scratch, for officially he was on the staff of Mr. Wallace, the superintendent. Everyone understood his ambitions, but he felt obligated to do something in return for the plutocratic salary of $20.00 a month which was drawn from Wallace's budget. It was for this reason that he passed a good many bone-chilling half-days that winter cleaning the kerosene lamps.

Presently, however, he was devoting his full time to the art of preparing birds, mammals, and reptiles. Looking back over the years, Doctor Granger deprecates his taxidermy and says that he never had "the touch" to become a true professional. Nevertheless, the experience furnished an excellent earn-as-you-learn course in zoological anatomy, a subject into which he delved more deeply as time went on. He shared living quarters with a young medical student who was interested in dissection and in whose company Granger enlarged his knowledge of the innards of the animal kingdom, not to mention their bones.

All this suited him well enough, but what he actually wanted was to get out in the field. A youthful wanderlust had first stimulated Walter's ambition to come to the Museum and when, after four years' time, opportunity at last presented itself he was not sorry to part company with the taxidermists. Though he has since lived in many places far from the refinements of civilization, never has he encountered anything quite so malodorous as some of the ripe cadavers the old New York Zoo delivered at the door of the wooden shed that sheltered the Preparations Department of that day.

Granger's first trip came in 1894 when he was dispatched by the combined Department of Birds and Mammals to collect specimens of living fauna around the paleontologists' field camp in the Big Badlands of western South Dakota. He wanted very much to go again the next summer, but funds were not available to send him on a full-time trip, and he had to make a compromise arrangement whereby he spent half his time collecting living forms and the other half exhuming their extinct ancestors. In this way he soon developed a profound interest in fossils generally and vertebrate paleontology in particular.

A career begins

It is an extraordinary thing how many scientific careers have been influenced by Dr. Frank M. Chapman.* And it is noteworthy that Doctor Granger, ranking second only to Chapman in years of Museum service, should also credit the Bird Curator with having determined in some measure the course of his life.

Soon after Walter arrived at the Museum, Chapman took a friendly interest in him and gave him many pointers on collecting, which he found useful on his first two trips. When he returned from the second of these, Walter had a long talk with his mentor. Chapman told him that if he was really hipped on getting in as much exploration work as possible, then perhaps bone-digging would prove his best bet. Accordingly, Granger transferred to the Paleontology Department, which had been in existence only three years and whose field work was then under Doctor J. L. Wortman. The latter set him to work at once, on the earn-as-you-learn basis, enlarging his knowledge of the sciences of geology and general zoology in preparation for life as a paleontologist.

Granger attributes to Doctor Wortman a large responsibility for his success. Instead of poring over musty volumes in some library, Walter picked up his bone-lore in long chats around the campfire in the Black Hills or among the arid buttes of Wyoming, where the paleontologists of that early day were opening up rich fossil fields. The intricate manipulative process of extracting specimens undamaged from Mother Earth cannot be learned from a pocket manual, and the ancient word-of-mouth method of instruction enabled Wortman to communicate many of those intuitive skills which are so difficult to capture and transmit through the medium of the printed page. Granger was like a young physician accompanying a veteran doctor on his calls, learning diagnostics and surgery by actual experience.

The long succession of summer expeditions which followed brought the young "digger" into contact with the last of the old West. Prairie schooners could still be seen rolling over the plains. Indians were everywhere, mostly on reservations into which Granger and his various associates often penetrated in search of the remnants of creatures who had become extinct millions of years before the red man ever set foot on the North American continent. Some of the lawlessness which characterized the era of Buffalo Bill and the James Brothers was discernible even at that late date. And one night Granger sat by the campfire apprehensively peering at the shadows around him, watchful lest horse thieves swoop down on the expedition's mounts.

Before long his steadily increasing knowledge of field work equipped him to undertake a broad study of the Eocene deposits throughout the Southwest, and he was just beginning to get his teeth into this work when there came an unexpected opportunity that made his pulse quicken.

Henry Fairfield Osborn, then President of the American Museum and a paleontologist of distinction, became tremendously interested in reports emanating from Egypt of the work his British colleagues were doing on the other side of the world. In the Fayum, excavators had accumulated an absorbing collection of strange bones wholly new to science, and Osborn resolved to lead a party into the same region in the hope of at least approximating the collection in the British Museum. Granger was at once drafted for service in the Fayum. A *passe partout* from the pen of President Theodore Roosevelt quickly won the expedition all manner of official assistance. Everywhere they went doors were flung open, and they were most courteously conducted on a tour of the pyramids as well as all the other archaeological and paleontological projects near their route.

Their own collecting grounds lay along what had once been the shore line of the Mediterranean. Although they were a hundred miles inland, there was still, literally, a taste of the sea about the place. If you were of a mind to drop a grain or two of sand on the tongue, you would instantly notice a salty tang.

These sandy wastes yielded a rare array of beasts. There was Moeritherium, who may possibly be the evolutionary grandfather of the elephants, and Arsinoitherium, a giant rhinoceros-like creature related to no other known animal. Credit goes to Granger for having discovered the first specimany of these specimens to be brought home to the United States.

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* See the present writer's "Apostle of the Birds," NATURAL HISTORY, January, 1940, p. 48; "Gambler on the Gobi," February, 1940, p. 118; "Chapin of the Congo," September, 1940, p. 123; "Birdman of the Open Sea," January, 1941, p. 54.

When the Egyptian trip ended, Granger returned by collecting in the western part of the country, spending on his study of the Eocene. Then in 1921 plans began to materialize for probably the most thoroughly organized piece of scientific exploration in history. This was, of course, the celebrated Central Asiatic Expedition under Roy Chapman Andrews. Granger was anxious to go along, and Andrews was equally anxious to have him as second-in-command. For, since very little living fauna could be expected in the Gobi Desert, paleontology would undoubtedly be the most important phase of the undertaking.

One hundred and twenty-five camels transported their supplies, while eight Dodge trucks took the party far into the unknown vastness of interior Mongolia. Andrews, the leader, was almost overwhelmed by the enormous problems of organization which rose out of the welter of Asiatic political disruption, and in matters of pure science he found it necessary to rely more and more on the judgment of his second-in-command.

In fact, Andrews considers that Granger was every bit as responsible for the success of the Central Asiatic Expedition as he was himself. For the better part of ten years they worked together as a team, Granger assuming full responsibility during Andrews' rather frequent flying trips back to the States to raise funds.

The personalities in this two-man team complemented one another. Andrews was the impetuous type, the driver, his eye turned toward the horizon. Granger, on the other hand, was the conservative—careful and deliberate, with a hound's capacity to nose out a buried bone. Andrews has summed it up with characteristic vigor. "I was the accelerator," he says, "Walter was the brake."

Toward the end of the first year, the party found itself faced with a long homeward trek across completely unexplored territory. A feeling of snow was in the air, and Andrews feared the heavily laden vehicles would bog down, leaving the expedition open to possible attacks by bandits and, at best, seriously delayed. Naturally, he wanted to reach organized civilization with all possible haste. Then Granger spied a big promontory in which he felt sure that valuable material could be found. Andrews consented to stop for lunch and allow time for a rough survey. Nothing was found. The leader ordered the expedition to move on but Granger insisted that the region looked too good to pass up. He pleaded with Andrews for one more look around. His superior's every instinct was to push on. Yet so great was his respect for Granger's judgment that he acceded to the request.

Granger went over the terrain again with that peculiarly penetrating eye which amounts to a sixth sense and is attainable only through long years of experience. He came upon a combination of geological phenomena which convinced him that a valuable bone deposit was in the offing, and sure enough it was.

Countless rare fossils were found during the next nine years, largely because Granger insisted that he could "smell" them and begged Andrews to call a halt. Thus it seems that if the leader had always had his way, half the collections of the Central Asiatic Expedition would never have seen the light. "But," Andrews declares, "if Walt had been running the whole show, we'd be digging away in the middle of the Gobi this minute."

The marvelous thing was that the teammates never had anything resembling a serious disagreement.

Of men and crises

Andrews considers Granger the best-natured man he has ever known in his life. But at two critical moments in the course of the expedition the second-in-command erupted. The first incident occurred during a siege of sandstorms, any one of which might have blown the tents halfway across Asia. To forestall any such calamity, Granger securely anchored his tent to the rear of a Dodge truck which was parked outside. As this particular sandstorm began to subside, Andrews found that the expedition water supply was a little low and he ordered one of the Chinese work boys to drive off to a nearby water hole. The Oriental leaped into the truck, threw out the clutch and ripped off. So did the top half of Granger's tent.

It seems that the customary Chinese reaction to censure is a broad grin. This so infuriated Granger when he launched into his tirade that he achieved a towering passion, the sight and sound of which has remained indelible in the memory of all witnesses.

The second outburst was the result of cumulative stresses and strains. Under the brink of an eroded cliff, Granger had made a breath-taking discovery—a cluster of bones which he knew to comprise a perfect specimen of an extremely rare aquatic rhinoceros (like everything in the unexplored Gobi, absolutely new to science). The piecemeal extraction of this precious fossil was a most delicate task which the second-in-command dared not assign to anyone else, not even to his immediate superior.

Granger accounted Andrews a good man at hunting fossils but he found it unwise to let his teammate linger long in the vicinity once a specimen was located. The leader's brusque methods of removal were enough to bring tears to Granger's eyes, and whenever a badly mangled bone showed up in camp, someone was certain to remark, "This one got the R.C.A. [Roy Chapman Andrews]."

Following the discovery of the rare rhino, Granger started out joyously each morning for the cliff, trudging uphill with his "bad lands gait"—a peculiar, paleontological roll akin to a sailor's "sea legs." Assembling his rice paper and the various shellacs and adhesives requisite to the scientific exhumation of crumbling bone, he set to work with all the tenderness of a mother handling her newborn babe. Bit by bit, he conjured the fragile parts from Nature's sandstone vise until a sizable pile of neatly sorted fragments began to accumulate on the canvas he had carefully spread out on the narrow ledge.

Enter Andrews. He starts down from the top of the cliff (Granger grimly reflecting, "Of course, it never occurred to him to come up from below.") sending a shower of loose shale pelting onto the canvas. Granger, through clenched teeth and with a strangely neuralgic smile, assures him that things are going nicely. Yes, quite nicely. When he got back to camp he would tell him all about it, but for the present he would very much like to be alone.

More digging. More meticulous prying and chiseling. The unwelcome load of shale has been painstakingly weeded out and the perfect specimen is beginning to take shape.

Enter the camp dog, who scampers across the canvas barking happily and wagging his tail. Those at the camp below heard a bull-like roar echo from the cliffs. That night neither man nor beast was safe. Hell knoweth no fury like a thwarted paleontologist.

The next morning, Granger returned to his eyrie, muttering that he had fixed things at last. The camp dog was chained to a tent pole and the second-in-command had threatened to shoot on sight the first-in-command, or any other biped that ventured to approach the cliff.

An almost complete skeleton now lay upon the canvas, every joint and knuckle in its proper place.

But Granger had left two members of the camp out of account. There came a fluttering of wings, and these two suddenly appeared—a pair of red-billed crows, beloved but insatiably acquisitive mascots of the expedition.

With a groan the paleontologist attempted to brush them aside. Manfully he concentrated on his work. Then something made him look up. One red bill was pointed skyward, and in frozen horror Granger watched the last of an irreplaceable chunk of vertebra disappearing down the gullet of a Chinese crow.

Looking back on the incident he reflects sadly, "Pets are like that. We had another mascot, a young wild ass. One night it was blowing up cold and Mackenzie Young borrowed somebody's felt-lined leather vest, shoved her forelegs through the armholes and buttoned her up. Next morning we found she had broken her tether and gone. A half-day's search with a car failed to locate her. Far as we know, there may still be a wild ass running around Mongolia wearing a leather vest."

Life in China

With the coming of winter, the thermometer plunged below zero. The howling gales that sweep unobstructed across the Gobi made further work impossible, and each autumn the expedition would repair to the main headquarters—a spacious compound in Peking, which included an acre of land and was surrounded by high walls. Here the staff could make use of complete laboratory equipment and other facilities and, for a while at least, settle down to enjoy themselves in the foreign quarter of that historic city. In some respects this well-earned rest proved more hazardous than the actual work. "Peking was my downfall," Doctor Granger mutters.

After a rigorous athletic existence in the desert, he found that autumnal indulgence in the delights of cosmopolitan life resulted in a waistline which is now, if not too ample, certainly ample enough. "Too much Chinese cooking," he says with mixed emotions, "and too many rickshaws."

But the winters were not spent in the lap of luxury. If the climate in the Gobi obviated collecting, there were more clement parts of China which might well bear investigation. Accordingly, Granger boarded a Yangtze River steamer bound for Yen Ching Kou, where he would take up residence in the ancestral temple of the T'ans. Although the region could hardly be termed unexplored, the trip was not without danger. The owners of Chinese junks, who had formerly monopolized river traffic, resented the steamers and had no compunctions about taking a few pot shots at a passing ship, particularly when they were almost capsized by her wash. The latter factor may have spoiled their aim to some extent but it did not make life aboard the steamer any more secure. A bullet was apt to crash into the dining saloon or whistle across the deck at any moment. And there were more formidable antagonists than junk men.

During most of the three seasons that Granger operated in this vicinity, the armies of various feudal lords were almost constantly skirmishing along one or both shores of the Yangtze. Once the steamer even sailed into the thick of a fair-sized battle, which Granger watched through his porthole while shaving. Whenever he transferred to smaller craft, he was always liable to an unexpected burst of rifle fire or to having his boat, equipment, and coolies confiscated by some petty military authority.

His mission in these parts was a curious one. For centuries the Chinese have been using "dragon bones" in specific compounds for particular ailments. The bones are usually fossils (it was in the drug shops that the first paleontological specimens from China were secured), and Granger had traced some of them to their original source—the digging grounds around Yen Ching Kou. Here the wholesale drug merchants purchased their wares, and Granger resolved to follow their example. It was folly to wait until the dragon bones had been brought down the river, since they are not sold in their original form but pulverized and either taken "straight" or in an alcohol tincture, or even fried in grease. Such pharmaceutical refinements undoubtedly render the bones more appetizing but scarcely enhance their value as scientific specimens.

Granger found that collecting in this area required considerable modification of the methods which he had learned in the Black Hills region and applied in Egypt and the Gobi. Instead of a "digger" he became an auction buyer and, under duress, something of a burglar. The technique was to leave the confines of his temple early in the morning and make tracks for the shafts wherein the dragon bones were being mined by the operatives of the drug merchants. He would stand at the brink of the pit, keeping a careful eye on everything that was brought to the surface. Whenever he spotted something unusual, he was prepared to outbid the drug merchants. These worthies did not relish the competition of his fancy prices. But Granger felt rather kindly toward them, although, as he expresses it, "the gratitude of the paleontologist is tempered somewhat by the abhorrent thought of all the priceless skulls and skeletons which have been ground up in the drug shops. Still, what has been eaten has been eaten and after all, nature, with her erosion of fossiliferous strata, has ground up more specimens than even the most populous race of humans could possibly have done."

Granger's scientific compunctions caused him to wince frequently at the butchery of local collecting methods and he soon felt compelled to offer a bonus for special care. But this "mass-production" fossil collecting had other drawbacks. So many excavations were being worked simultaneously that he was unable to be on hand at all of them and had to rely on bold forays into dark storage places within and beneath the diggers' homes to keep pace with the "finds." In no other country on earth would paleontologists make a practice of poking under people's beds with a flashlight, frantically seeking to salvage the thighbone of an extinct rhinoceros before it made its fateful downstream journey to the drugstore. Although circumstances frequently obliged him to barge in without permission, Doctor Granger never resorted to larceny. He paid handsomely for his bones and secured so much good will that his trespassing was not only tolerated but actually invited.

Temple workshop

When his strangely acquired collections had attained sufficient bulk, Granger retired to the gallery of his temple to "work them up." This he could do in comparative peace so long as there were no armies on the march, press-ganging his coolies into transport service. To guard against the lat-

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[illegible], Granger [illegible] any delusion of grandeur. Rather, it [illegible] general [illegible] among the *wai jên* (foreigners: literally, "outside men") at that time, which raised the coolie above the ordinary rank and gave him the protection of his master's prestige. But sad was the fate of the lowly villager, especially if he was getting on in years. Whenever an army appeared, the young men fled, taking with them all the valuables they could carry. Only the feeble remained. These pitiful old gaffers were routed out of their hovels and forced to stagger up the rough hillside under military burdens so heavy that they often dropped dead from exhaustion and sheer terror of the gun muzzle in the small of their backs. Granger was appalled at the cheapness of human life in China (the soldiers themselves risked their lives for no more compensation than the promise of two meals of rice a day), but it was all he could do to keep his own skin and property intact and he looked on from the comparative safety of his temple, heartily agreeing with General Sherman's famous dictum.

In peaceful times, Granger's only interruptions came when the caretaker of the temple, himself a T'an, arrived each morning and evening to burn incense and kowtow to the ancestors—a ceremony which he had reserved the right to perform under the terms of the lease. Once the evening ritual had been completed, recreation was in order, and the T'an family, together with their neighbors, frequently amused themselves by watching the "outside man" eat his dinner. This annoyed Granger at first but he soon became accustomed to it and consumed his food with the Jovian gusto appropriate to his exalted position.

Meals were usually served outdoors on the gallery where Granger spent nearly all his time even in near freezing weather. Not that he had much in the way of choice. There was no central heating nor, for that matter, any fully enclosed room except the kitchen.

Granger ate or puttered with his fossils clad in a long, woolen robe. Between his feet, completely enveloped by the robe, was a charcoal brazier or fire basket by which means he managed to keep warm. Later on, when Mrs. Granger joined him, he found it necessary to secure sleeping accommodations for her at the inn next door. This had nothing to do with heating facilities (which were if anything worse at the inn) but was in deference to the religious prejudices of his landlords, who would not countenance a woman sleeping among the honored spirits of their forefathers. Granger conformed to these scruples most of the time. But whenever the inevitable army showed up, he moved Mrs. Granger right back into the temple. The T'ans were taking elaborate precautions for the welfare of their own kin and they quite understood.

Archetype

The state of the world in recent years has hardly been conducive to foreign exploration, and since 1930 Doctor Granger has had to confine his field work to the western badlands, where he made his first trip so many years ago. This area has not yet been exhausted by any means, and probably never will be, for Granger counts on a new crop of fossils to weather out every ten years or so.

There are also memories. Today he can be found of a winter evening comfortably ensconced in his favorite chair at the Explorers Club of which he is an ex-president and incumbent director. He can spin many a yarn of the 28 separate expeditions in which he has served during his 40-odd years of exploration on three continents, and he will always find an eager audience.

An honored man of science and a dean among American vertebrate paleontologists, he seems now an archetype of his kind—a pioneer, part of a tradition that is unhappily fast disappearing from the scene.

Doctor Granger never finished high school. Yet he is not only an acknowledged leader in his chosen science, but an abundantly informed student of all Nature. A few years ago, Middlebury College in Vermont bestowed upon him a doctorate *causa honoris* and each June he enjoys going up for commencement week at his adopted alma mater. At heart he is still a Vermont boy—a native son who, despite all his travels, likes nothing better than the autumn foliage around his boyhood haunts and a good Thanksgiving dinner at Rutland.

In an era of nostalgic veneration for horse and buggy doctors, lawyers and preachers, it is perhaps not out of place to describe him as a country naturalist—one whose wisdom, like those of his counterparts in other professions, is somehow a natural thing rather than a systematized product of cloistered scholarship.

YOUR NEW BOOKS

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SIBERIAN TRAPPER ● BIRD COURTSHIP ● EARTH SCIENCES
INDIANS ● GLASS FLOWERS ● MUSEUMS AND YOUNG PEOPLE

EARTH SCIENCES

- - - - - - - - by J. Harlan Bretz

John Wiley, $2.25

THE multitude of sciences embraced in the broad field of geology are interrelated and also are closely related with other fields of study. Just as the paleontologist must be conversant with the morphology of the recent representatives of the various animal groups with which he is concerned, so also do the students of the physical history of the earth need an understanding of the principles of meteorology and oceanography. Yet, insofar as this reviewer is aware, this book is the first to present the basic facts of these related fields in simple, relatively nontechnical language.

This book is designed primarily for use in the relatively new type of college course designed to survey science as a whole and present it as an integral part of a liberal education. As such, it is essentially a textbook; a textbook into which a great mass of important detail has been condensed. In this condensation an effort has been made to avoid both the ponderous technical terms of the average text as well as the "froth of light words" of most books of popular science. The effort was only moderately successful, but nevertheless this is a book to be recommended to the intelligent citizen anxious to learn something of the facts of physical geology and of the related sciences of meteorology and oceanography.

H. E. VOKES.

MULTIPLE HUMAN BIRTHS

- - - - - by Horatio Hackett Newman

Doubleday, Doran, $2.50

FROM a long study of the phenomenon of twinning, Professor Newman has distilled this vastly entertaining and instructive book which he has filled with the answers to the questions that frequently occur to most of us, twins or not.

The fact that there are two kinds of twins—one-egg or identical, and two-egg or fraternal—is of enormous significance to scientific research in human heredity. The one-egg twins, because of their origin from a single ovum and a single sperm, share a common genetic pattern. The two-egg twins, on the contrary, are no more alike genetically than any pair of offspring from the same parents. Thus, although the former twins are genetically alike and the latter are unlike, the two members of either kind of twins normally share a similar environment. This nice arrangement permits the student of genetics to examine the relative significance of environment and heredity. Newman has found that in no case is the environment or the heredity exclusively the all-deciding factor, although one or the other may be of greater significance. In physical traits, it is generally heredity; while in personality traits the environment often plays a dominant rôle.

In the pursuit of his twin studies, Professor Newman began to encounter identical twins separated in infancy or childhood and reared apart. These cases, although difficult to find, offered an exceptional opportunity to observe the effect of differing environments on twins with identical heredity, and after a prolonged search, full of human interest, a series of 20 sets was eventually established. The report on these separated twins contributes an absorbing portion of the book.

Although *Multiple Human Births* was intended for popular reading, Professor Newman has managed to include an unexpected abundance of information without overweighting his text.

H. L. S.

WILDLIFE CONSERVATION

- - - - - - - - by Ira N. Gabrielson

Macmillan, $3.50

DOCTOR GABRIELSON has written a manual of sound conservation practice, one which will make a strong bid for acceptance as a standard text on the subject. His experience and position qualify him as an authority on Federal conservation policies. The book is well-written, comprehensive and direct. It covers a very broad field and hence cannot go into great detail, but the fundamentals are accurately defined and a basis provided for giving full consideration to the conflicting interests which enter into conservation controversy.

The author starts his discussion with an outline of the factors which control ecologies, the working of the vital forces, the part played by soil, water, vegetation, et cetera, and the influence of man who has himself become one of the major influences. The subject is systematically and logically developed and the reader is carried from the simple and obvious truths of conservation to their application in the instances where they conflict with the vested interests or the larger groups who view wildlife resources from a conditioned perspective.

Gabrielson stresses the need for active conservation groups, education of the public, research to get all the facts, and the importance of continually pressing for the establishment of constructive conservation policies. He discusses the moot problems of the waterfowl shortage, control of predatory and injurious animals, and the rights of the sportsman versus the nonshooting public. Many who read *Wildlife Conservation* will fall into the category of those who have taken sides on one or more of these issues. Regardless of which side that may be, they must concede that Gabrielson has suggested solutions which seem logical and likely to work out for the best interests of the most individuals. Some of these solutions are being carried out in practice. It is to be hoped that, in the near future, one can be assured all of the field activities in this country are living up to the constructive theories advocated by Doctor Gabrielson.

H. E. ANTHONY.

DERSU THE TRAPPER

- - - - by V. K. Arseniev, translated from the Russian by Malcolm Burr

Dutton, $3.00

DERSU THE TRAPPER is an interesting, descriptive narrative of life in the Tiagá, a forest of incredible density, in eastern Siberia. Arseniev, the author, explored the region north of Vladivostock in Ussuria in 1902, 1906, and 1907. His story is centered around a Gold trapper. The main occupation of the Golds, a branch of the Tungus tribe, is hunting and fishing and they have a wonderful reputation for their truly noble qualities. This trapper, Dersu Uzala, was not only a master woodsman of great endurance who read the forest like a book, but he was a man of great understanding and considered the welfare of both man and beast. The gradual unfolding of his character is a wonderful testimonial to these people of the Far East.

This book has definite literary, as well as scientific, worth and will prove invaluable to anyone planning a trip to the wilds of eastern Siberia. Arseniev enumerates the details of his expeditions, and no one can doubt his authority in this sphere. He was known and respected by both scientists and laymen throughout eastern Siberia. I met him some years ago in Vladivostock and found him a quiet, sympathetic fellow with a wealth of knowledge of the country and people.

Dersu, like other tribesmen of the maritime province, regarded the tiger as a god.

[illegible] interesting and a pleasure to both old and young alike.

[illegible]

YOUTH IN MUSEUMS

by [illegible] M. Moore

[illegible] Press, [illegible]

T[illegible] with the title *Youth in Museums* must be [illegible] ment if he reads the fifth and sixth chapters which give a representative picture of the modern museum—one teeming with activities for youth of varying ages. Such are found now even in museums planned for adults.

This book is the result of Miss Moore's study of the work for children in museums, made possible by funds from the Rockefeller Foundation. Following a definition of children's museums, the volume is concerned with desirable qualifications for the staff, selection of collections and methods of exhibiting the objects to aid in their interpretation. Then follows a survey of educational activities which supplement organized school work and those designed for after-school and vacation periods. The author also includes a description of methods being used for financing children's museums through the formation of auxiliaries, and completes her study with an enumeration of anticipations for the Young People's Museum of the future. As a guide to what is being done with young people in museums and possibilities for furthering this work, the volume is adequate and competently written.

[illegible]

AS LONG AS THE WATERS RUN

by Angie Debo

Princeton University Press, $4.00

THE title of this book was suggested by the oft-repeated clause in Indian treaties that the agreements shall stand "as long as the waters run," which promises [illegible] pudiated every treaty made with Indians whenever covetous white men desired their [illegible] State of Oklahoma by which the Five Civilized Tribes were deprived of their lands [illegible] revealed in documents, official reports, [illegible] statement is well documented. In these days, when people are shocked at the ruthless despoliation of minorities in Europe, it would be well to look at the fate of the Indian minorities in Oklahoma.

It is a familiar idea that tyranny and [illegible] oppressors as well as those of their victims. If anyone entertains doubt upon this point he should read this book. He will observe how judges, officials and citizens participated in despoiling orphaned and dependent Indian children and applied the same methods to negro children. Kidnaping and murder were frequent methods in intimidation and the brazen seizure of property. The jury system was futile because white citizens would not convict their fellows. Some Indian children were proved to have died of neglect while their white guardians lived on the incomes from the victims' property.

These abuses seem to have reached their maximum about 1925. Under Roosevelt's administration the crisis of the depression made grafting less and less profitable, enabling the more conscientious citizenry of Oklahoma to institute some reforms, but naturally abuses still continue. The author shows that now the Federal Government is collecting tax money from all its citizens to pay for the relief, rehabilitation and education of the Indians in Oklahoma. Perhaps the kindest way of looking at it is that Oklahoma destroyed a large part of its potential resources and now looks to the United States as a whole to pay the bill.

[illegible]

COURTSHIP AND DISPLAY AMONG BIRDS

by C. R. Stonor

Country Life Limited, London, 8/6

AMONG courtship activities, the displays of birds are almost as familiar as their songs. There has been great need for a popular book on the subject, with examples chosen from many different groups of birds. As Mr. Stonor says, general conclusions cannot be drawn from the behavior of a single species. Evolution in display has kept pace with the development of plumes, wattles, and other adornments.

The whole field, if surveyed in detail, would require many volumes of the size of this book. So here the questions of song and territory are scarcely touched upon. There is a minimum of psychology and physiology; emphasis is placed on the ways in which courting birds make the fullest use of ornamental plumage and other decorative features.

The splendid illustrations consist of 57 photographs from several continents, by a number of ornithologists. Those of the birds of paradise, the lyrebird, various species of grouse, bustards, and argus pheasant are particularly striking.

[illegible] Mr. Stonor points out what seems to be an evolutionary development of display. Where the male bird is much the more ornamental he is likely to display actively but help little, if at all, in nesting. Among other birds where the sexes are much alike, both often join in mutual display.

Communal displays may involve a number of brilliant males, as with the ruff and certain grouse, assembling to await the duller females; or they may be conducted by several pairs indulging in mutual display, as with albatrosses and gulls. When continued after courtship is past, display seems to become a social [illegible] as with bowerbirds and lyrebird.

The primary function of display—despite its extreme diversity among different birds—would seem to be the stimulation of both sexes toward pairing and the successful rearing of young. Mr. Stonor picks examples that illustrate the close connection between behavior and structure, as well as the progressive modification of [illegible] congratulated on his success.

James P. Chapin

GLASS FLOWERS

by Fritz Kredel

Harcourt, Brace, [illegible]

THE Ware Collection of glass flowers in the Botanical Museum at Harvard University includes thousands of models made by the Blaschkas during the period from 1887 to 1936. From these models the series of sixteen on insect pollination has been chosen for reproduction in the color plates of this book. Accompanying the illustrations are explanations of the mechanism of pollination in these species. In the Introduction is a brief history of the making of these models and the way in which they were acquired by Harvard University.

[illegible]

TEXTBOOK OF GEOLOGY, PART II: HISTORICAL GEOLOGY (Fourth Edition)

by Charles Schuchert
and Carl O. Dunbar

John Wiley, $4.00

A NEW edition of "Schuchert and Dunbar" will be recognized as an important event by all students in the field of historical geology. It is also worthy of notice here, for while strictly a textbook (and the most successful textbook in its field, as evidenced by the fact that the third edition was used by no less than 212 colleges and universities) this book is at [illegible] readable compendium of the known facts of the history of the earth and of life upon the earth.

This is a textbook, and as such is not designed for easy popular reading, but neither is it simply an arid presentation of facts. It is the work of specialists detailing the dramatic story of the history of our world.

To the many amateur geologists and paleontologists to whom I have recommended the earlier editions of this work it will suffice to point out that it has been largely rewritten to include all the important new discoveries in the science. A new chapter has been added, explaining the methods and theories involved in reading and interpreting the record of the rocks. More than one-third of the illustrations are new and all of the paleogeographic maps have been redrawn to a new technic and are up to date.

This book, as the most useful that has as yet been published, is recommended to all who are interested in earth history.

H. E. Vokes.

A BOOK OF GARDEN FLOWERS

- - - - - - - by Margaret McKenny

Illustrated by Edith F. Johnston

Macmillan, $2.00

WITH what cheerful vitality and charm the artist has endowed the familiar garden flowers pictured in the glowing lithographs in this little volume! Each of the thirty-three color plates is worth framing. Like the previous companion volume, *A Book of Wild Flowers*, the arrangement of the plates is according to the season, beginning with the first crocus blossoming through the snow in spring, and ending with the chrysanthemum of autumn. Opposite each plate is a page of description of the flower's habit, habitat, and legend, and an illustration of the fruits or seeds of the plant. This is not a manual of cultivated flowers but a skillfully designed and most attractive presentation of some of our garden favorites. While it is written and arranged for children, adults will enjoy it, too.

J. W. Thomson, Jr.

NATURE IN CHINESE ART

- - - by Arthur de Carle Sowerby

John Day, $3.75

THE subject of this book should be of great popular interest, but Mr. Sowerby has not done justice to it. His articles in the *China Journal*, on which the book is based, were sometimes popular, sometimes fairly scientific, seldom thorough, and they have not been rewritten well enough to give the book proper accuracy or unity.

Mr. Sowerby tells us that his aim has been to determine the species of the plants and animals represented in all forms of Chinese art. He rightly objects to faulty identifications by others, but his own dogmatic corrections are sometimes petty or far-fetched.

For example, he cites one of a class of Shang bronzes which have always been described as owls, and disagrees with this attribution because of small differences in anatomy; yet he later shows a series of jades intended to represent cats which require much more imagination to guess their identity. He goes on to explain that the owl appears rarely in Chinese art for the same reason that it is absent from Chinese poetry. It has not been absent from Chinese poetry, though, and even if it has long been discarded by Chinese artists as a bird of ill-omen, we have no way of knowing if it meant that to the Shangs.

If this is not a proper scientific work, neither is it an interpretation of Chinese art. In spite of his background, Mr. Sowerby remains a zoologist with little artistic sense. The photographs show all too many tasteless bibelots introduced merely to show animals and plants. Why did he not include a few more of the bird paintings which he lists in such tedious detail? The most unique illustrations are the photos of fantastic mountain scenery, included to show that Chinese landscape artists did not have to let their imaginations run wild.

The best feature of this book are the tables by Harry Gibson, showing some of the pictographs found on Shang bronzes and oracle bones. The value of these is that besides illustrating the process by which Chinese characters developed, they picture the daily life in Shang, methods of hunting, fishing, planting, etc. Mr. Gibson's conclusions about Shang writing in the two appendices to this book sometimes tend to cloud the historical picture, however. For instance, he never gives the "proofs" for his unique convictions that the men of Shang rode as well as drove their horses and probably did not cultivate rice.

S. V. R. Cammann.

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Director of the United States Fish and Wildlife Service

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•

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•

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FINE SPECIMENS

By CHARLES H. COLES

(Chief Photographer, American Museum of Natural History)

MOST of us who are interested in natural history have collections of one kind or another: rocks, minerals, shells, Indian relics, travel mementos. If you have a camera, you also may make interesting photographs of these specimens in much the same manner as the Museum of Natural History records some of its objects. You may want to give an illustrated talk. In that case, the first step is to take good photographs of your specimens, from which lantern slides can be made. Or you may want to have the objects identified by a scientific authority without the trouble or risk of sending the objects themselves.

The first decision to make in photographing, let us say a mineral specimen, is what purpose the picture is to serve. Is it to demonstrate exactly what the specimen looks like for scientific record, or is the specimen to be "glorified" with a more artistic appeal? Let us assume that an accurate representation is the basic requirement, for on this groundwork the photographer can develop his own favorite tricks in artistry.

The scientific record

The first step in making accurate record pictures is to ensure the elimination of all background details that might detract from a clear portrayal of our mineral specimen. Shadows on the background are also an interference that must be removed.

A camera that is arranged to make photographs vertically, that is, with the lens pointing straight down, is the answer to these problems. A miniature camera may be mounted vertically by using that Jack-of-all-trades of the chemist—the ring stand. A ring stand equipped with a large metal clamp will hold the camera over the mineral in many different heights and positions. Larger cameras will require heavier stands.

After a suitable vertically-operating camera is obtained, the stage must be prepared for the specimen. A sheet of glass larger than the field covered by the camera is supported four or five inches above a sheet of white paper. Another clamp on the ring stand upright will hold the glass, or several blocks of wood may be used. On this glass the specimen is placed.

The illumination

When the specimen is illuminated, it will cast shadows on the white background. Often it is possible to arrange the lights so that the shadows fall far enough away from the specimen to lie outside the picture. If a shadow does come within the picture area, an extra lamp may be flooded onto the white background sheet to obliterate it.

As a rule, diffused light is best for small specimen photography. Daylight (not sunlight) is one of the softest and most satisfactory sources of light. Set up a white reflecting surface near the side of the specimen, away from the light source, to

[illegible]

[illegible] always ready to make the photograph.

Where two sides of a specimen must be shown with sharp relief two sharp light sources are required. Direct sunlight and sunlight reflected from a mirror may be used or two spotlights. Illuminating two surfaces of a single specimen in this way may require very careful light positioning.

With experience it will be found that it is possible to light a single specimen satisfactorily showing all its characteristics; but lighting two or more specimens in one photograph can only be accomplished by sacrificing some of the details of each. No one lighting will be correct for more than one specimen. It is best therefore to concentrate on one object at a time.

LETTERS

Sirs:

[illegible] Natural History [illegible] I have seen and [illegible] the most interesting of the magazines that I read.

Mary M. [illegible]

[illegible]

• • •

Sirs:

The Natural History Magazine [illegible] for the past four years. We look forward with anticipation to another "Natural History" year.

Charles [illegible]

Newaygo, Mich.

• • •

Sirs:

Very many thanks for your kindness in sending copies of the chart . . . I was a little apprehensive about their arrival, as some mails posted about that time were lost at sea. . . . The December issue, however, arrived safely, and I should like to congratulate you—above the monthly debt of congratulation which each issue incurs—on the great beauty of its cover design.

G. E. S. Turner.

University Museum
Oxford, England

• • •

Sirs:

May I congratulate Charles H. Coles on the Kodachrome reproduction of the Siberian tiger on the cover of the February issue of Natural History Magazine. To me it represents one of the finest cover illustrations we have had in a long time. I certainly look forward to seeing more from time to time, both on the cover and in the Magazine proper. . . .

H. C. Koenig.

New York, N. Y.

• • •

Sirs:

Included with this letter you will find a check covering my annual dues for 1941. I should like to tell you how glad I am that despite the mess Europe is in your wonderful paper still gets through to Switzerland regularly. It is one of the few bright spots left, now that traveling abroad is quite impossible. I am sure that Natural History is the most interesting and the best-presented paper of its kind—there certainly is nothing like it in Europe.

C. A. W. [illegible]

Berne, Switzerland.

Sirs:

. . . I praise most highly this magazine which I receive monthly. . . .

Horace D. [illegible]

Brooklyn, N. Y.

• • •

Sirs:

I have subscribed to your magazine, I think, four years, and look forward to it above all others that come to our house . . .

Ralph S. Howe

New Britain, Conn.

• • •

Sirs:

. . . I take this opportunity to tell you my thankfulness and deep appreciation for all the joys and satisfaction of every kind that Natural History Magazine is bringing me month after month and year after year.

I am more than thankful that I could receive all the numbers of the Magazine, so far, in spite of the European situation. I cannot imagine what it would be to have to go on without it, and I hope firmly to be able to receive it always.

There is nothing you would wish to add to this magazine, because it is simply perfect, each copy is a treasure which brings with it knowledge and pleasure. To you all, editors, writers, and illustrators who make it what it is, I wish to extend my sincere gratefulness.

Dr. Charles D. Chessex

Lausanne, Switzerland

• • •

Sirs:

I have my American Museum certificate and my first copy of Natural History Magazine. I am delighted with the Magazine and sorry I did not apply for membership in the Museum long ago.

A. R. Allen.

Trinidad, Colorado

• • •

Sirs:

During the past year I have been particularly interested in the articles contributed by Martin Birnbaum. Mr. Birnbaum's brilliant mind, broad sympathies, and facile pen leave one feeling almost as though one had traveled with him, certainly wishing one could. I hope there are to be more.

Hugh Wightman.

Hartford, Conn.

Sirs:

We keep the magazines themselves intact in my office for a long time—as long as they will keep, for I find that they "walk off" and I lose about five out of every year's file. . . .

H. A. Roberts, M.D.

Derby, Conn.

• • •

Sirs:

I was greatly interested in Isabel Harper Blount's article "A Lynx in the Home" . . .

Garnett Prentis

Baltimore, Md.

• • •

Sirs:

I was much interested in the article "World's Highest Waterfalls" in the December, 1940, number of Natural History.

During 1912, 1913, and 1914 I spent the season from June to December in half a dozen trips covering most of the mountainous region between Lake Louise and the Peace River. My primary interest was in settling the northern limits of *Ovis canadensis* [mountain sheep]. . . . This work I did in the interests of the Biological Survey, although these trips were my own personal trips. . . .

Our last trip in 1914 took us five months to reach Hudson Hope from Jasper and return. During that trip we discovered on the Murray River (which we referred to as the East Pine) a very fine waterfall about 250 feet high. No one, to our knowledge, had been into this country, except possibly Indians hunting and trapping, because of its inaccessibility and the difficulty of travel, caused by burnt over country and bad down timber. We saw no recent signs—trails, blazes, etc.—near the falls. Farther down the river we found old blazes made by Indians traveling by canoe, about 20 years old. At Hudson Hope we did not find anyone—trapper, Indian, or trader—who had ever heard of these falls, which we called Kinuseo Falls, from the Cree word for fish, as the pools in the river were full of Dolly Varden trout. The falls were very beautiful, although when we were there in October the water was low. At high water they would be exceptionally fine.

The only other person whom I know definitely to have seen the falls was Prentiss N. Gray, whose curiosity, aroused by an article which I published in *Appalachia* (Vol. XIII, No. 3), caused him to make a hurried trip through the eastern area. . . .

S. Prescott Fay.

Framingham Center, Mass.

April

NATURAL HISTORY

1941

Lost Empire in the Jungle • Diamonds • Roy L. Abbott

William K. Gregory • Blue Geese in April • New Guinea

OLUME XLVII. No. 4

FIFTY CENTS

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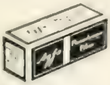

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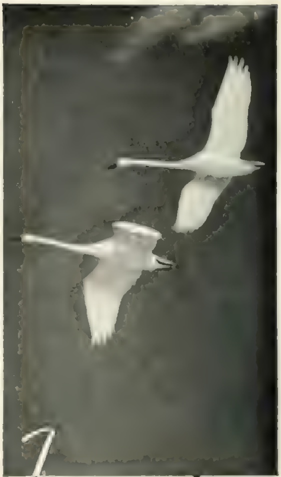

Natural History

ILLUSTRATIONS

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COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration painted by F. L. Jaques, from Bird Group of Hudson Bay Region in the American Museum of Natural History

LETTERS

Sirs:

Natural History merits higher praise than any individual can ever give. I look forward to each issue with intense eagerness and can hardly wait for the next copy to arrive.

This publication is truly the best magazine offered to the American public. No one can help appreciating the rich covers, exceptional photographs and drawings, and vivid, lucid articles. It not only adds much to one's happiness, but it also gives one a broader, more conclusive knowledge of the earth's life and history. I find it to be a great relief from the monotonous, depressing tales of the newspaper.

Especially liked in the February issue were "A Dinosaur Walks into the Museum" and "The Mystery of the Fig." I was particularly fascinated by the Siberian tiger on the cover.

Daniel V. Boese.
Tigard, Oregon

* * *

Sirs:

. . . Your publication is surely outstanding, in reading matter and in general make-up of the Magazine itself. My compliments!

I. A. Maguire.
Minneapolis, Minn.

* * *

Sirs:

Readers of Natural History must thank you for a rich feast in the March issue: rocks, bears, cacti, birds, and fish . . .

Frank Place.
New York, N. Y.

* * *

Sirs:

My fourth-grade children have both enjoyed and learned a great deal from several issues of Natural History which were brought to us by a child in our class.

Frances Robinson.
Memphis, Tenn.

* * *

Sirs:

. . . I should like to assure you of our appreciation of Natural History, which is read with interest as it arrives, by the members of our staff.

Neville Jones.

The National Museum of Southern Rhodesia, Bulawayo, Southern Rhodesia

* * *

Sirs:

. . . I much appreciate having this excellently illustrated and well got-up magazine, and should like to keep my set complete, if you can please replace the missing number.

I can put up with my house being damaged, so long as my library remains intact . . .

L. J. Spencer.
London, England

* * *

Sirs:

. . . Your publication is most excellent, and you are doing a wonderful work.

Eli Abbott.
Greenwood, Miss.

* * *

Sirs:

. . . I would not choose any one issue as better than the rest. They are all fine, and for the few years that remain to me, I hope never to be without Natural History Magazine. It gives me my most enjoyable and instructive reading.

Alhambra, Calif. George E. Angell.

* * *

Sirs:

. . . Natural History is by far the most interesting and attractive of the many magazines published, and I would not want to be without it. It helps to keep alive my interest in all phases of nature study, and is read over and over, many times. I find it a most valuable reference magazine, and treasure every number.

Richard F. Deckert.
Pflueger Marine Museum
Miami, Fla.

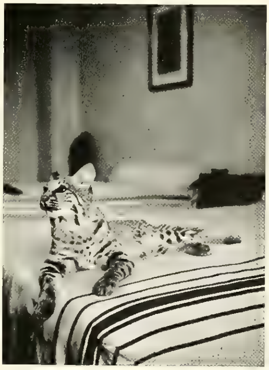
* * *

Sirs:

Your magazine is a perennial joy and education, and it is a wonder how you manage to sustain the high standard. I look forward to it with keen interest and read every article.

Doctor Gudger's article on fishing dogs in the last number was particularly interesting, but it is not necessary to pick out one from the many. All are so good.

Henry Wyckoff Belknap.
Salem, Mass.



Sirs:

I was most interested in Isabel Harper Blount's article, "A Lynx in the Home," since I have a lynx in my home, a twelfth-floor New York City apartment . . .

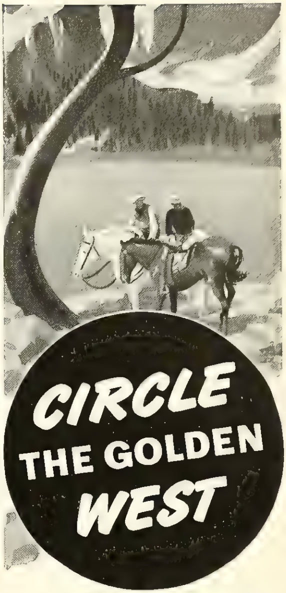
New York, N. Y. Maria Leiper.

* * *

Sirs:

Your magazine, in my opinion, is the finest in every detail covering the field of natural history. In fact, it is beyond competition. Those responsible for its production deserve the highest praise. The reader knows that it is authentic, and that is a great satisfaction. I do not have words at my command to express my full appreciation.

A. J. Kopp.
Allentown, Pa.



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sire.

[illegible] returned from the Island of Formosa, where [illegible] I [illegible] a few unusual pictures which may be of interest to readers of NATURAL HISTORY MAGAZINE.

[illegible] of the photographs illustrate the so-called "pestle-chant" produced by the women [illegible] on the shores of Lake [illegible], a body of water [illegible] The women have discovered that the wooden pestles they use for pounding their millet [illegible] according to the size of the particular pestle. Thus, when different-sized pestles are tapped intermittently and rhythmically upon the flat rock, a weird music is produced. This is accompanied by [illegible] of the women [illegible]

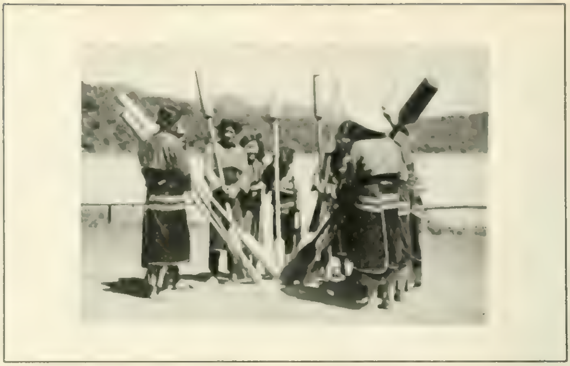
Two other photographs show a native design carved in wood exhibiting a stylized snake motif, and a pair of carved totems typical of the work of aboriginal tribes.

The tattooed designs of the natives of Formosa, shown in the remaining two photographs, are especially interesting. The "pussy-cat" mustache tatooed on the face of the woman is a characteristic sign used by the ex-head-hunter tribes of Formosa to indicate that a woman is married. The tatooed mark on the chin of the man tells the world that he has captured at least one enemy head, so that we might say it is a sign that he has "gotten ahead in the world." Note that he now wears a semi-military uniform, which is supplied by the Japanese to all the male ex-head-hunters for use at all times, even in the field regardless of the intense heat of tropical Formosa. The women too are dressed by the Japanese in cotton kimonos, which are symbolic of a movement that will rob another one of the few remaining native groups of the world of their own traditions and culture.

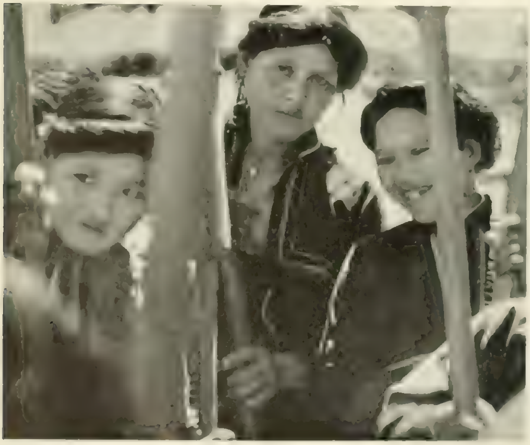
HARRISON FORMAN

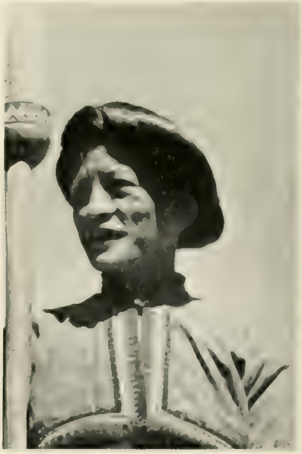
Port Washington, N. Y.

[illegible]



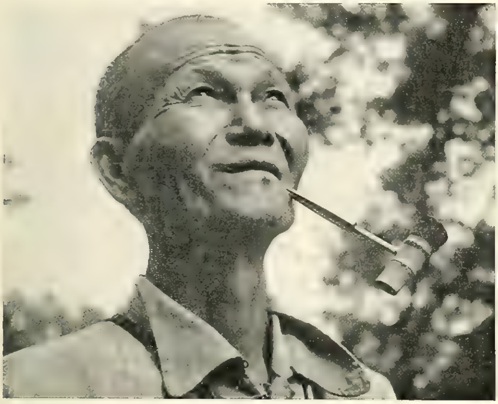
TOOLS MAKE MUSIC in Formosa when the women pound out their "pestle-chant"





A STYLIZED SNAKE MOTIF in the wood carving art of Formosa

CARVED TOTEMS typical of the work of the aboriginal tribes



THE TATTOOED CHIN of the man above means he has taken a head. The woman's "pussy-cat" mustache is a sign she is married

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Roy Chapman Andrews, Sc.D., Director

VOLUME XLVII—No. 4 ★ ★ ★ ★ ★ ★ ★ **APRIL, 1941**

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You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

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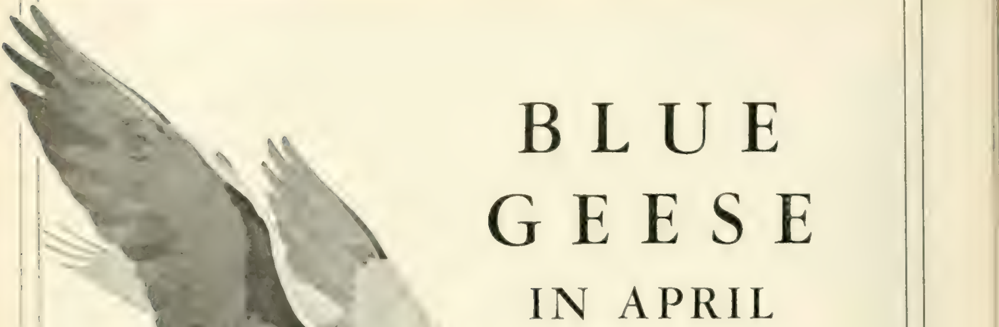


PARTNERS IN FLIGHT: blue goose and snow goose

BLUE GEESE IN APRIL

By FLORENCE PAGE JAQUES

With Illustrations
By FRANCIS LEE JAQUES

Adventure rides at your side when you follow the Minnesota flyways into a world of wings to see a living snowstorm break the spell of winter

A[illegible] transparent, it was not springlike. As a matter of fact it was growing more and more bracing, to say the least. Clouds prowled toward us until the sun gave up its dominance and disappeared. The country went back into wintertime.

I had been enthusiastic when Lee suggested this trip to Lake Traverse, along the border line between Minnesota and South Dakota, so that he could make sketches of the blue and snow geese on their northern migration. But I had pictured balmy weather. I saw myself floating in a canoe, sheltered by green leaves, one hand trailing in the water while the other lazily scrawled a few notes. Or perhaps lying full length on a heaped hay wagon (Mr. Breckinridge had taken pictures of the geese in that way), slowly moving through fields where the birds were feeding. All my idea had been languorously colored with sun and greenness.

Now these fields were a sullen brown; and remnants of snowdrifts lingered along the ditches. The land became very flat, with scribbles of trees faint against the horizons, and the great skies I remembered as typical of Minnesota looked stormier every moment. Farmhouses wide apart, misshapen strawstacks, water standing in fields—all gave a melancholy imprint to the landscape.

"I wouldn't be surprised if there would be a heavy snow," Lee said expectantly.

But then, in the small ponds scattered at random, we began to see ducks, and that sight always lifts our spirits. Pintails came down into a cornfield. I often think my favorite duck is the pintail, with its slender, aristocratic grace, its immaculate gray and black, the snowy stripe up its neck like a Beau Brummell stock, and the tail spike which makes it so delightfully easy to identify. (At least, I always think the pintail is my favorite until I see cocky black-and-white scaups bobbing, or a little ruddy with its ridiculous fan of a tail, or a powerful canvasback coming down fast, or the brilliance of a wood duck flashing by.)

At two o'clock we reached Wheaton and engaged a room at the small hotel. Then we sped out to Traverse. This large lake, about 20 miles long, has as its northern end a wide marsh which is approved highly by wild fowl.

We took a sandy road leading across its bleak expanse to the South Dakota hills on the other side.

Cold clouds blew past us, but except for them the refuge seemed completely deserted. We discovered a few scaup ducks, chunky and alert, in a silvered curve of river. Around another bend swam six mergansers, whose wild crests always make me think of them as the savage chieftains of the duck tribe. But there was nothing flying in all the great expanse of ice-gray air.

After crossing the marsh we stopped on the rampart of the western hills. We left the car to scan the marsh with our field glasses. Down the lake there was no open water; it was frozen white, very discouraging for birding. Lee began to climb a cut-bank.

I looked at the desolate expanse. Where were all the gay bird songs I had hoped to hear? As I retreated to the car, seeking harbor from the fierce wind, I saw a string of birds high in the air over a southwest hill. Was it?—they didn't fly like ducks—Yes! They were in a wavy line, they *were* our "wavies!"

"Lee!" I called wildly. "Geese! Geese!" What staggering pride I felt in finding them first and how elated I was to see blue geese once more.

Their long journey

For blue geese are the most dramatic birds imaginable. For a long time they were an almost complete mystery to ornithologists, since they stayed close together and were extremely aloof to the rest of the world, though quite sociable among themselves. They kept their breeding grounds secret, and on their migrations they flew so high and so far that it was difficult to trace them. Only in the last few years was their breeding place discovered—a remote and isolated spot above the Arctic Circle on Baffin Island—, and that discovery is a story in itself.

The blue geese stay there and in nearby places during the short summer, and in the fall they move south to James Bay, where they meet the snow geese, who mingle with them on migrations. From there the geese buoyantly make a nonstop swoop, so high in the air that they are rarely seen, down to the coast of Louisiana. Here the blue geese almost all flock together in the marshes west of New Orleans, while the beautiful snow geese are much more widely distributed. Lee and I had spent several weeks out in the Rainey Sanctuary, on a very small island in the middle of a marsh 30 miles wide and hundreds of miles long, watching the geese fly by and seeing them gather on the marsh flats.

Now we had encountered them again.

Lee with his field glasses found another flock far to the north, and we started out to discover where they were lighting in. Rain began to fall. We took the small roads which clung to the marsh most closely and slithered along, stopping for glimpses of ducks flying. A burrowing owl stood on his vigorous legs on the top of a fence post and looked at us with a dire severity much too large for him. Finally Lee caught a glimpse of geese lighting down.

"There they are," he said. "Now they're coming for the night."

Small flocks began to whirl in. Though it was still raining, we could see black silhouettes floating down from the heights they had attained, their sudden sideslips and then the swift descent through the mist to sanctuary. We were too absorbed to get hungry until it was too dark to see.

Back at our hotel we congratulated ourselves on having engaged our room early, for it was a good little hotel and evidently well known to traveling salesmen. As we ate a bountiful turkey dinner I was glad the proprietor did not know I had bought crackers and cheese and fruit in Minneapolis, in case the meals were too forbidding. After dinner, Lee called the game warden we had been told to see.

"He says the geese shuttle back and forth," Lee reported. "Go to the fields in early morning to feed. Usually fly back to the marsh later, back to the fields in early afternoon, and to the marsh again at sunset for the night. He's offered to take us out tomorrow morning."

That was said a trifle too casually. "How early in the morning?" I asked, looking at him sternly.

"He'll be here at five," Lee said in a very matter-of-course voice.

"That means four-thirty for me! Do you know how cold it is?"

"It may be quite warm in the morning," Lee began, and laughed in spite of himself.

Geese in the night

We went to sleep at nine. At eleven the geese awakened us. So long since I had heard geese in the night; I was delighted. Their cries sounded all about us. Geese calling in the rain,—it was like a poem. But the calling went on and on, till I became first indifferent and then discouraged.

"Great guns, I hope they aren't leaving for the north," Lee said. But before morning we were longing for them to leave for points north or south, east or west, or wherever they thought best. They bombarded the hotel with wild yelling, the whole night through. Fog thickened the rain, and I suppose they were confused by the town lights, but they were certainly relentless in their perplexity. Each bird seemed to fly straight at our particular window to give his supreme shout.

"How could I ever have thought their cries were thrilling?" I moaned to myself. I remembered snatches from a lyrical paragraph I'd written about [illegible] turbing it. . . ."

[illegible]

But, "Yah-yah-yah," went the little geese, on and on.

[illegible] to wake up. The room was black and icebound. I [illegible]

[illegible] lobby, we arrived on the sidewalk just as the warden drove up in his roadster. We started out through the night.

[illegible] said the warden. "Rained like the mischief last night."

Bitter cold came through the window when we [illegible] specks curled up against the dim Dakota hills.

"They're starting out," the warden said.

Though the sky was darkly clouded, I saw far off along the horizon a rim of clear ice-green sky. Flocks [illegible] us. Flock after flock poured out, hundreds of birds flouting the morning wind.

Now they began to come over lower, so for the first time we could really see the details of their sharply drawn beauty. The blue geese were a dusky blue-gray with necks and heads of white; the snow geese with them were a pure white with black wing tips. This contrast made the varying groups even more intricately lovely as they arrowed through the immensities of the Minnesota sky. The wings that carved the clouds, now faintly flushed with dawn, were more stirring than banners.

"More snow geese than I've ever seen," Lee was saying. "In Louisiana there were only a few for every hundred blues. Here at least a third of them must be snows."

"Thirty-five per cent," the warden answered. "Want to follow them? No telling where they'll feed. They choose a different spot every day."

Back along the rough road again, we followed hard after the speeding birds. We took slippery wet roads around the town and off to the east. Geese were still skimming past, so far above that we felt unsure of attaining their goal. But the warden had no uncertainty, and at last we could see where they were dropping down from the blue-green sky into the yellow fields.

Soon we were close to a spot where they had begun to feed. The number of birds in the cornfield, where grain had dropped from last fall's crop, seemed limitless. We watched them, all facing into the wind, walking along the rows of broken cornstalks, serious and preoccupied. Small flocks flew up continually to light again in advance of the compact army. More and more geese arrived.

"Lord, how I like to see them come in," the warden muttered, as a bright flock sideslipped suddenly and hurled down through the scathing wind with rigid wings.

Through the glasses I watched the bright eyes, the crinkled satin of white necks, the steps taken meticulously by coral feet. These birds were not as large as the Canada geese, but they had even more pride of bearing. And when they flew up, how easily they rose, as lightly as bubbles! No gathering of energy; they simply wafted off, so closely companioned that their wings overlapped one another.

"Well, that's all that's coming, I guess," the warden said. "Want your breakfast? You can come back afterwards and see them leave for the marsh."

But when Lee and I did come back, there was no flying. The fierce wind must have discouraged the birds, for they stubbornly stayed on the ground between the furrows. We remained as stubbornly in the car and watched them work in closer and closer till we could see every feathery ripple, every motion of their busy feeding. This was the only chance they had at grain during the year, so they made the most of it.

A living snowstorm

We amused ourselves by opening the car door to make them fly up momentarily so that we could see the whole world full of sharp-cut wings, pure white and shadowy blue. To be in a snowstorm of living birds, thousands making a dense curtain all about and above us, so that we could see nothing but patterned flight, while the ground was darkened with wing-shadows,—this was a curious bewitchment.

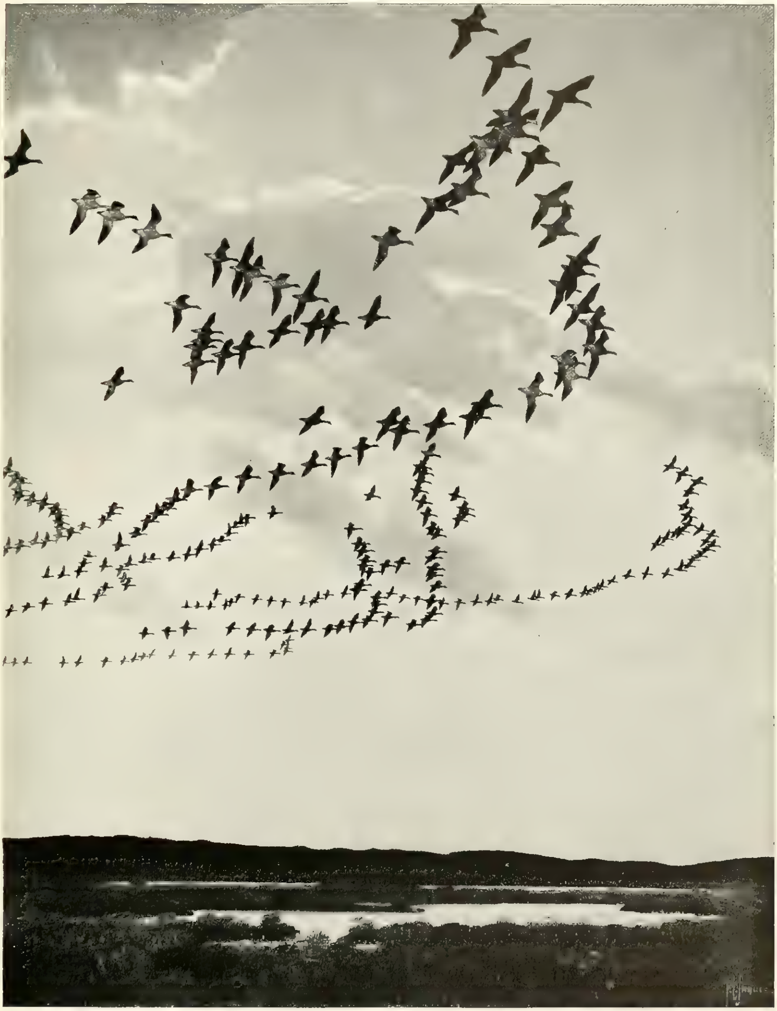
The afternoon was more arctic than the morning, clouded and colorless, with hardly a bird anywhere. We sat in the car by the marsh for a long time, but only a few pintails happened along. Not even a burrowing owl to amuse me. Where was my sunny water and my drifting canoe? There was not an inch of green in sight, not a single blade of fresh grass.

At four, to our surprise, the geese came back from the fields and hurriedly sought shelter. We watched them, but they were too far away to be as spectacular as they had been in the morning. The warden, watching, too, at the schoolhouse corner, said with relief, "Now I've put them to bed, I can go home. Boy, is this a cold day!"

"We might as well go in, too. There won't be anything else to see. We had our luck this morning."

But it was long before dinner, so we decided to drive south along Lake Traverse, even though it was frozen over. We might see something. But first we'd take the road across the marsh, just to find our mergansers in the river. They were there, and also the childish scaups, undismayed by the films of ice already stiffening across the shallows. We also found a pond extravagant with redheads, mallards, and teal, which delighted Lee.

Momentarily spots of sun lighted the windswept hills, the ruffled water, and the brown gradations of the marsh. I ventured out of the car to look at the exquisite, bronze skeletons of grasses, but the icy wind tore at my hair and skirts till its assaults drove me inside again. A bit of intense blue sky among the heavy storm clouds and the orange twigs on the low bushes near us were the only dashes of color in the whole great landscape.



From a painting by Francis Lee Jaques

WINGS ACROSS THE SKY: blue and snow geese in April flight [illegible] began to melt. Excitement broke through like the bit of bright sky above us. I had never seen enough pintails to satisfy me. Now I was getting intimately acquainted. [illegible] lovely in its precarious flight.

[illegible] pintails," Lee said.

[illegible] A turquoise sky with gilded clouds mocked us from the east. Great flights of pintails fled past, with the late sun turning their white stocks to faint gold. I had never seen enough pintails? Now we were at- [illegible] upon thousand.

"We'll never see more pintails than this," Lee exclaimed. "The warden told me there was a huge congregation in Iowa. These aren't local ducks; they're coming up from there. I've never hit a migration right on the nose like this!" He was making hasty sketches in his notebook. "There! More geese, too, beyond that line of ducks. I thought they were all in."

More and more geese came in constant lines from the clarity to the south, like a refrain repeated over and over. "Probably been blown off their course," Lee said. "Look how they have to fight against the wind."

"But Lee," I gasped at length. "More strings are coming. Look, look over that hill! As far as you can see!"

"You know what?" Lee said slowly. "This is the real blue goose migration. The ones we've seen all day were only the vanguard. This is the main flight coming in." He swept the sky with his glasses. "They look like swarms of mosquitoes over those hills."

"You mean we're being lucky enough to see them arrive from the south?" I asked incredulously.

Against a scarlet sun

Dark clouds lurched up in the north and west. A spectacular sunset flared red behind them, blurred by a snow squall. The geese flew swiftly in **V**'s and lines across the scarlet light and the black storm. And from the east and south, where the sky, like midsummer, now had clouds like floating heaps of pale carnations, geese were repeating themselves as far as we could see. The multitudinous lines filled the great sky from the horizon hills to the levels far to the north.

The sight was so tremendous and exalting that we almost wished the birds would stop coming so that we could catch our breath. Now, as it grew later, flocks came low over us. The heads of the dark birds were delicately pink, and the snow geese were transformed to shimmering rose. What ecstasy they brought us as they cut hard against the wind!

I felt I could not stay in the car. So I leaped out valiantly, field glasses in hand,—to lose my hat and have my coat blow up around my head and blind me as I ran after it. By the time I conquered one and caught the other, I had hit myself on the chin with the field glasses and was chilled to the bone. In spite of my husband's unsympathetic grins, I was glad to get back in the seat beside him.

Blue dusk was creeping over the low, violet hills. Still the geese swept by and still pintails were flying in, slender against the dark. "I can't look any more," I said exhaustedly. "It's too splendid."

As we drove back to the hotel: "Did you ever see anything as wonderful?" I said.

"No, I've never seen a huge migration come in before, and to see two at once *is* luck."

"How many geese, do you think?"

Lee is always cautious in his statements. "A hundred thousand, I'd say, and 50,000 pintails. Of course, I've seen more birds at one time," he went on reflectively. "The auklets in Bering Sea, for instance. And on the bird islands in Peru I saw nine million cormorants and pelicans. But those birds don't begin to touch our wild fowl! You, my child, have just seen one of the great sights of the world."

We rode along in silence for a while.

"But I simply can't get up and look at geese again tomorrow morning!" I said. "I've seen too many. It would be an anticlimax. Let's stop." However after several cups of strong, hot coffee I changed my mind. I couldn't miss seeing the hordes once more.

"Though not too early! It's so cold I know the geese will sleep late, too. You've always said geese were extremely wise," I begged.

But we were up and out at five. It was almost zero,—eight above, the thermometer showed. We groped our way out of the dark hotel toward our dark car. But this morning I felt insulated by excitement.

The whole earth was as black and hard as iron. We lost our way once, to our distress, for we were afraid of being too late for the uprising. But when we found our road, the only life we saw was a couple of disgruntled baldpates in the ice-fringed river. The marsh was dim, and a pale, freezing light in the east did nothing to cheer a dead world. There was not a sound to be heard when Lee stopped the car by the marsh. After a moment, a little cloud of geese rose up and then settled comfortably back into bed again. How sensible! Nothing more happened, not for ages and eons,—except that my feet turned slowly into two ice cubes.

Just as slowly the sky cleared except for tatters of cloud in the east. Much later a red sun appeared at the horizon, with snow flurries blown across it. Just then there was a second swirl of dots rising above the hill and settling back again. Then there was perfect quiet.

The sun touched the west hills and turned them cherry color, except where a few cloud shadows kept them deeply purple. Still no geese flew. We noticed how a small pond had its ripples frozen into ice, and how each reed had a delicately fashioned cup of ice curving high around its base, above the pond's surface, where the water had been blown up around it by the gale the night before.

At last the marsh itself was sunlit. How frozen it looked! And we were frozen, too. Lee didn't have enough gas to run the motor constantly, and the car was now like a frigidaire. We heard a western meadow lark bravely give its brief sweet song. It was spring in Minnesota.

Now the sun was bright. But still no sign of life came from the marsh. We would have decided that the geese had gone if we hadn't seen those two attempts at rising. I wanted to mention that I had said they wouldn't get up early, but I thought perhaps it would be better to be wise, like geese.

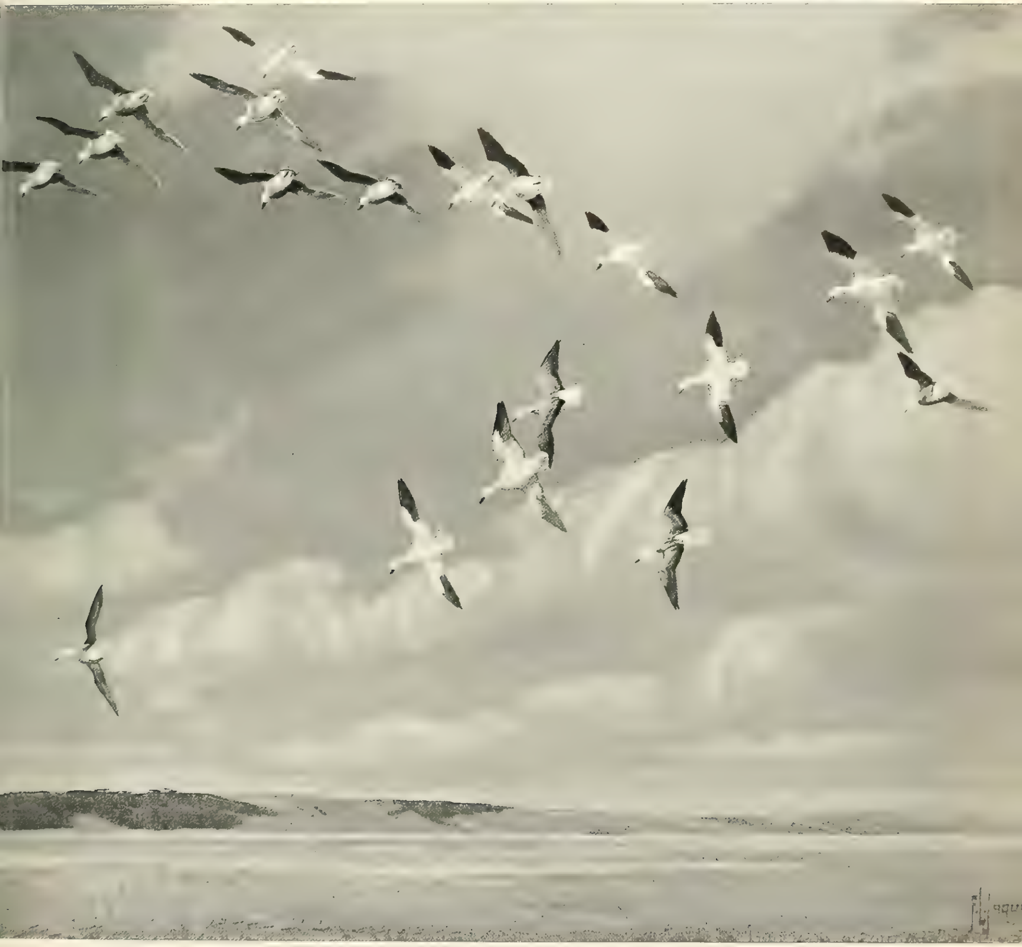
Perhaps they were escaping over the Dakota hills, instead of coming our way? But the air was as lucid as crystal; we surely would have seen them. Our spines were long icicles now. We surrendered suddenly and dashed back to Wheaton for hot cakes and sausage, hurrying our waitress frantically so that we could gallop back before the geese awoke.

But, of course, they had leaped up as soon as our backs were turned. We were just leaving town when I sighted our quarry. In the vast blue the ranks of geese were speeding east above us, line after line, **V** after **V**.

At the marsh we left the car for the open where we could see all around us. This was a more torrential flight than the evening one, for instead of being all over the sky, they came past like a river. They were directly over us, and in the clear air we could see every feather in their radiant wings. The snow

Sideslipping Down: blue geese, (blue-gray with white necks and heads) and snow geese (white with black wing tips) descending by slipping sideways to right and left

From a painting by Francis Lee Jaques



[illegible] the [illegible] sky, the blues a striking contrast in the sun.

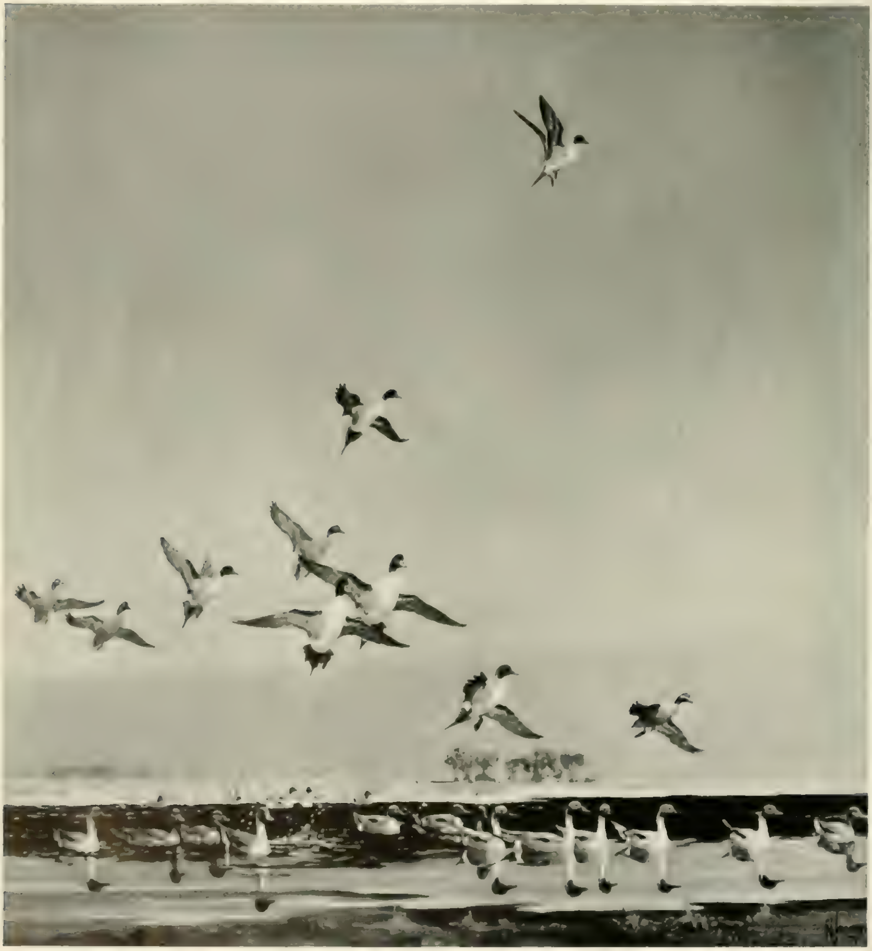
[illegible] flew in every formation: V's, long ribbons, and straight lines. This river in flight [illegible] from the marsh bottoms to heaven, and [illegible]. On [illegible] morning my heart responded to their wild cries with inexplicable rapture.

Still they rose from the marsh like a column of smoke and flowed out into their splendid channel. Great white clouds appeared like miracles in the blue [illegible], and the flying wedges shifted [illegible] them. This morning the motion of wings was not slow and half-drifting as yesterday's flight had been. It was very clear and hard.

The complicated tracery of wings in the air, close over us, farther and very far, the cries, the clouds, the [illegible] wind—all made an ecstatic confusion in the senses. The sky in the east was pearl-white with clouds, and the lines of geese were very high. We forgot about the earth. We were in the air, encompassed in the magic [illegible]. We had lost our barriers—, and our spirits knew, for this instant, an ultimate liberation.

Pintails Rising From a Windy Pond

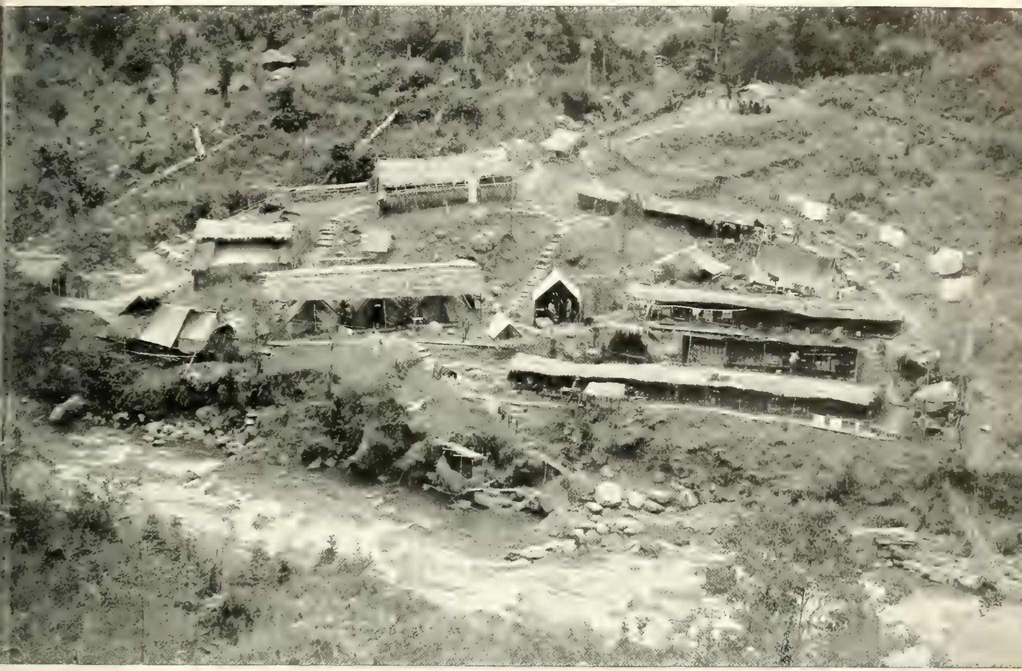
[illegible]



Latchkey to a Savage Tribe

By RICHARD ARCHBOLD and A. L. RAND

Research Associate, Department of Mammalogy, *Research Associate, Department of Ornithology,*
The American Museum of Natural History



Archbold Expedition photo

CAMP of the Richard Archbold Expedition in Grand Valley, a domain of Stone Age natives that was unknown until the expedition discovered it from the air. After several months at higher altitudes, members of the expedition occupied this river bank for further research and established closer contact with the natives inhabiting the valley. Though this camp stood at over 7000 feet altitude, the tropical sun was uncomfortably warm and grass shades were erected to protect the tents. The initiation ceremonies took place on the far side of the camp

The natives of a large hidden valley, who had never before seen white men, ceremoniously accept the members of an American Museum expedition and invite them to reside permanently in their realm

THE Pesegem and Morips live in one corner of the Grand Valley of the New Guinea Snow Mountains. Together with their neighbors, they number perhaps 60,000 persons, but the existence of their huge, heavily populated valley was unsuspected until we flew over it in 1938.

We came to them out of the sky. Our airplane *Guba* landed us at Lake Habbema in the mountains above their valley. Though this was a long day's journey above their villages and was on the edge of the alpine grassland, where ice formed each clear night, parties of these people continually passed our camp. Our relations with them were friendly but they remained few and distant so long as we stayed at these high altitudes. It was when we came to move down into their valley that we got to know them. They offered to help carry our material for us, and we had brought cowrie shells with us for trade. Though these little sea shells one-half to two inches long could be purchased in quantity on the coast, [illegible] We [illegible] at one shell for one day's work. And for [illegible] the natives carried our goods for us.

When we settled [illegible] village, it came as a surprise that they wanted to initiate us into their tribe. We were sprinkled with the blood of the pig and given the privilege of becoming permanent residents.

They waited until the last of us reached the grassland camp. From miles around the natives came pouring in to sit around the edges of camp. They explained to us that an important ritual was to take place. Some of them were Pongani, some Mongi; both tribes seemed to take part, but we could not distinguish them. This was early in the morning, but in New Guinea it is a land of [illegible] or wait a bit, so we were not surprised that nothing happened at once. Only [illegible] of natives sprawled over the hill; the men [illegible] near our camp, the women to dance on the clearing nearby.

It was chilly, as is usual at these altitudes, so the men were clustered about a little fire. Suddenly several men dashed to the fire with bundles of grass, wet from being soaked in the creek, and spread them over the fire and walked on them. We wondered at first if it might not be a fire dance. But no, evidently fires must be put out, for a one-eyed old scoundrel absent-mindedly started to light a cigarette, and though he was a man of importance, the cigarette was dashed from his hand. Some men were engaged in bringing in big slabs of wood, which had been cut with the stone adzes which these men almost universally carry over their shoulders. But now the rarer, heavier stone axes for the harder work of splitting the wood came into use. The logs were split up into firewood and kindling, and it was astounding how effectual stone axes were for this. Then several

One Cowrie Shell a day per man. Friendly but at first aloof, the natives offered to help the white men at this rate of payment for the task of moving their camp down into the valley from the upper heights. Their loads are five-gallon gasoline tins filled with rice. Their method of travel was a dash and a rest, then another

[illegible]

(Below) **In a Snakelike Line**, the expedition and its retinue move down into the grasslands of the valley

(Below) **Crossing Streams** on swaying logs was always perilous for the boot-shod members of the expedition, but the barefoot natives were as agile as monkeys

pigs slung over men's shoulders were brought, the men singing as they came. The younger men and those of evidently lesser importance were sent away, up to the dancing.

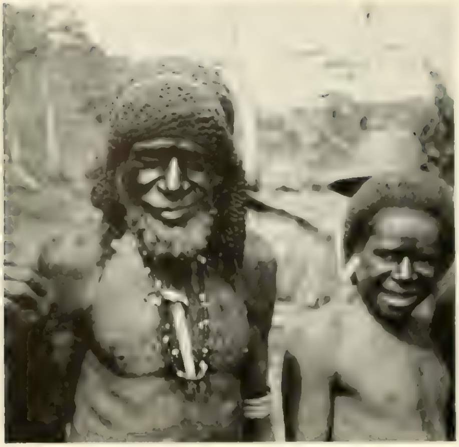
The pigs were now shot, one man holding the hind legs about shoulder high, another the snout, while a third standing about four feet away shot an arrow into the lungs. The pigs then were held in a small fire, and the natives scraped off the charred bristles and epidermis with their hands. Pits had been dug, fires were built and stones placed on them to be heated. When the stones were hot, they were put into the pit, which was lined with grass. Sweet potato tops were put in and then the pigs, which had been cut open with bamboo knives so that they lay flat. More sweet potato tops were added, then hot stones. The whole was covered with grass weighted down with stones and left to cook.

While this concoction was cooking, an old man took the pig livers, which had been roasting at another fire and were roughly cooked, and divided them into small sections with a bamboo knife. Another man took up each small piece of pig liver, touched it with a few small red feathers, and handed a portion to each of us, which we ate. This we learned definitely was a Morip ceremony. Then they led us up to the dance. There were about 250 men in one group and about 300 women in another. They had been singing and dancing most of the day, but now they were quiet. Men of importance led us around the groups of natives, apparently to inspect their fighting men and to admire the flower of their womanhood.

Then some of the old men appeared with handfuls of moss soaked with blood and water. These they held out in various directions, perhaps to points of the compass, perhaps in pertinent directions in the valley. There seemed to be some sort of invocation. Then the old men walked about the assembled men,

(Above) A View of the Valley showing scattered native settlements and fields tilled in a primitive way by some of the 60,000 inhabitants who are estimated to live in this hidden section of New Guinea

The Stone Age Natives, using only stone adzes, built crude overnight shelters like that shown at left. A Dyak brought from Borneo stands in front of this one

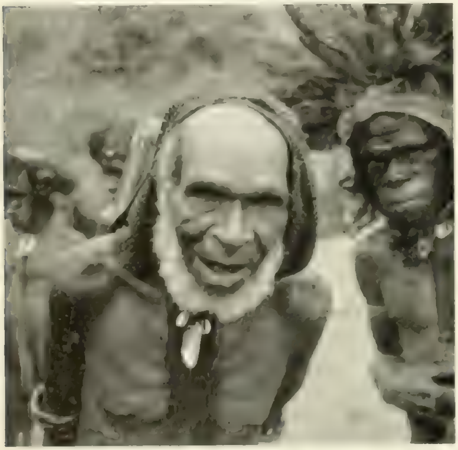


swinging the bloody moss so that drops spattered over the group. This finished, they turned to us and we, too, received a sprinkling of the blood. The women, who were now squatting down, removed their capes and they also received the sprinkling of blood.

As we stood looking over them, several small pigs were brought forward. To each of us was held out a small pig and a small bamboo knife with which to cut notches from the ears of the pigs. It was then explained that when these marked pigs had grown up and had long tusks, we could return to shoot them.

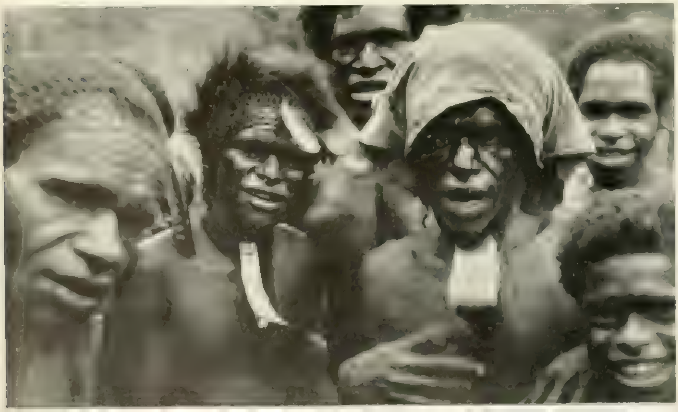
The ceremony seemed over, and as nearly as we could tell they explained that now we had eaten of the pig and were eligible to remain in the valley. By now the pigs roasting in the pits were cooked. They were dug out, and we were obviously expected to join in the feast with some of the older men. This we did for form's sake and really found the pig rather good.

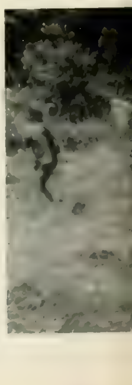
But there was one more thing. When we went back to our tents, old Gira, one of the important men of the Morip community, followed us and showed us a long strip of pandanus leaf on which there was but one shell. Now, shell is money in this country, and he pointed out all the places, about 18, on which there were no shells. The request was plain: we were to fill in the blank spaces with shells. It looked like a shakedown, but after all, if Gira came to our country, would he get off so lightly, with only a score of shells to pay?



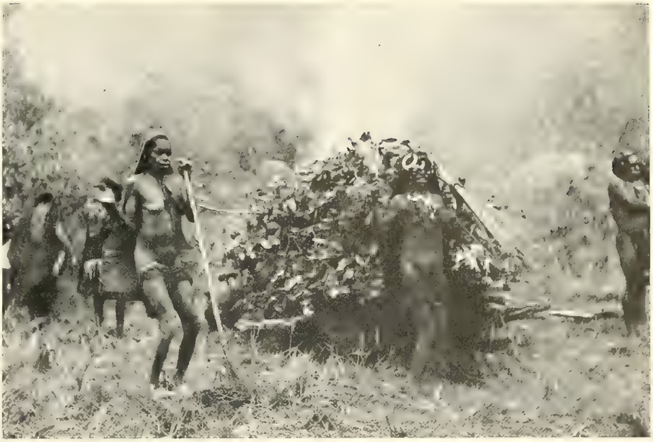
(Left and above) MELLOWED BY YEARS, the old men were delightful to know. A fiber-cord hairnet of distinctive style was worn by many of the natives. At the neck of the man at left hang two cowrie shells, which were used as money. The other wears the lower jaw of a rat, which is not strictly an ornament, as the sharp incisor serves as a small knife

(Below, left) A GROUP of the less responsible element, whose ornaments are made from tin cans acquired from the expedition





(Right) WARMING UP for the initiation dance. How the loose skirts which the women wore stayed on remained a mystery. Viewed from the front, they were almost nude; but behind, a net bag hanging from the head concealed the body. None of the women came very near the camp



(Right) THE CEREMONY gathers momentum. A group of men in the foreground is arriving to join the women who are dancing in the clearing

All photos by Archbold Expedition

(Below) THE MEN AND WOMEN danced in separate but adjacent groups

SPRINKLING of the white men with the blood of the pig was one feature of the initiation ceremony. Here one of the ceremonial pigs is being shot by means of a bow and arrow. The sprinkling was done, after an invocation, by some of the old men who swung handfuls of moss soaked with blood and water

AFTER being held in a small fire, the pigs were scraped to remove bristles and epidermis

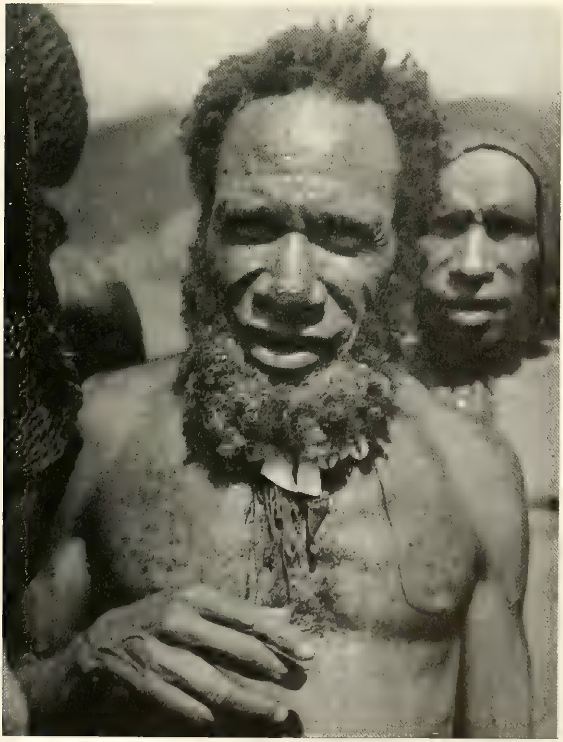
(Below) WEIGHTED with stones, the pigs were left to cook in the pits

(Below) ON A HEAP OF LEAVES the pigs were cut up for distribution. Afterwards a small live pig was held out to each white man, who was expected to notch the ears with a bamboo knife. This would mark them so that when the pigs grew up and had long tusks, the visitors could return to shoot them

Stones are being heated for the roasting pit, in the photograph above

Hot Stones have been put into the pit with the pigs and some sweet potato tops. The primitive oven is now being covered with grass

Gira, the man who received the "rake-off." After the feast, the hospitable natives were not loath to receive a few extra shells for their trouble



All photos by Archbold Expedition

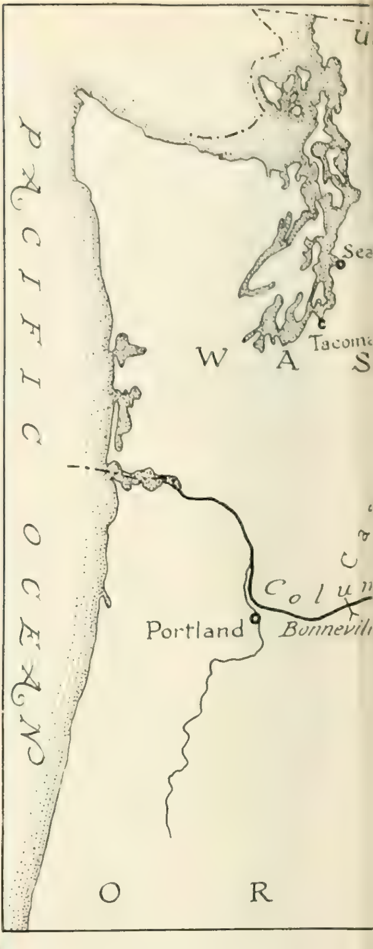
THE FIERY FLOODS THAT FORMED THE INLAND EMPIRE

By JOHN C. REED

Enough molten rock to cover New England to a depth of half a mile provided the pattern for one of Nature's most gorgeous and far-flung tapestries

OVER the vast country represented by the shaded area on the map at right stretch the great plateaus of the Columbia, our Northwest's "Inland Empire." Here in many a sun-drenched canyon and on many a wind-swept tableland have been enacted chapter after thrilling chapter of human history which have transformed this land of open distances in only a few short years from an unknown, apparently useless wilderness into an empire of thriving ranches, towns, and cities. Across these broad plateaus in 1805 Lewis and Clark dragged weary footsteps toward the Pacific. Today the traveler sitting at ease in the cabin of a transcontinental plane looks down on highways, railroads, and the yellow patchwork of wheat fields, as shown in the aërial photograph below. He beholds the mighty Columbia, gradually losing its struggle against man's determined efforts to halt its flow at Grand Coulee.

[illegible]



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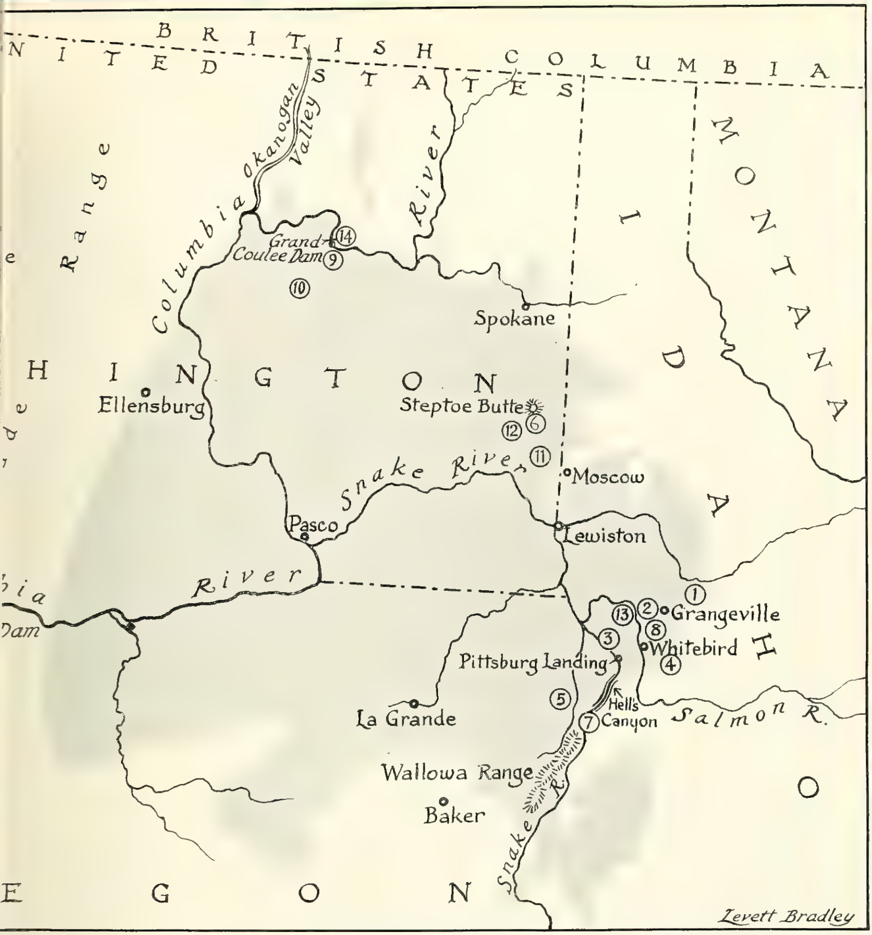
AT LEAST 35,000 cubic miles of molten rock flowed out upon the shaded area in the map above, to give the region that is now called the "Inland Empire" its distinctive character.

The numerals on the map show where the photographs illustrating this dramatic geological story were taken


BRITISH COLUMBIA
NITED STATES
Okanogan Valley
Columbia
Range
River
Grand Coulee Dam
⑭
⑨
⑩
Spokane
HINGTON
Ellensburg
Steptoe Butte
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⑥
⑪
Snake River
Moscow
Pasco
Lewiston
River
bia
Dam
MONTANA
IDAHO
①
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④
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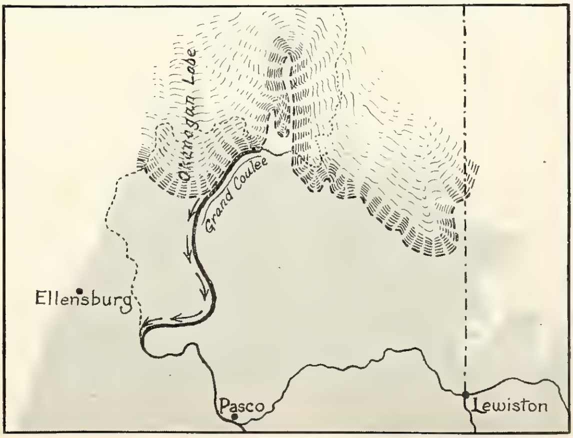
Grangeville
Whitebird
Pittsburg Landing
Hell's Canyon
Salmon R.
La Grande
Wallowa Range
Baker
Snake R.
EGON
O

Levett Bradley


Okanogan Lobe
Grand Coulee
Ellensburg
Pasco
Lewiston

In the Ice Age when the great glacier advanced down over much of North America it forced the Columbia River to follow the course marked by the heavy line on the map at right. The dotted line represents the present course to which the river shifted when the ice retreated. East of Grand Coulee, where the ice covered the present channel of the Columbia, the drainage may have been broken temporarily. At least while the ice was melting, rivers feeding the Columbia probably flowed from many points along the face of the glacier

WE HAVE TO START at the beginning of the geological story to include some of the most dramatic changes that have ever taken place in western North America and to find the reasons why the Columbia plateaus have become what is now called the "Inland Empire."

The event that forms the principal theme of this tale is the pouring out of immense lava flows. These lava flows—dozens, perhaps hundreds of them—were large enough to cover all of New England to a depth of more than half a mile. At least 35,000 cubic miles of lava! When and whence came this almost unimaginably large volume of seething, molten rock? And what has happened in the Inland Empire since the great lava floods?

Flow on flow of lava, interlayered at a few levels with lake deposits containing fossil leaves, are exposed where the canyon of the Salmon River cuts through Camas Prairie and Grangeville Mountain in Idaho, below

2

THE FOUNDATION ROCK, or "basement complex," over which the Columbia River lava floods poured themselves includes a great variety of rock types. These basement rocks are exposed where rivers have cut their way down to them, as shown in the photograph at right. Here the Snake River has deeply etched the boundary between Oregon and Idaho above Pittsburg Landing, cutting deep into the older rock beneath the lava floods. Whereas the lava beds lie in layers, as seen in the distance in this photograph, the older rocks lack this horizontal layering. They are largely hard, crystalline rocks, such as granites, marbles, banded gneisses, and greenstones. The last named are at least in part themselves ancient lavas, but they are so changed that their origin is difficult to recognize.

Most of these "basement" rocks have a distinct "grain," which trends in general north and south, although there are many exceptions. Because of this, many of the water courses, probably most of the

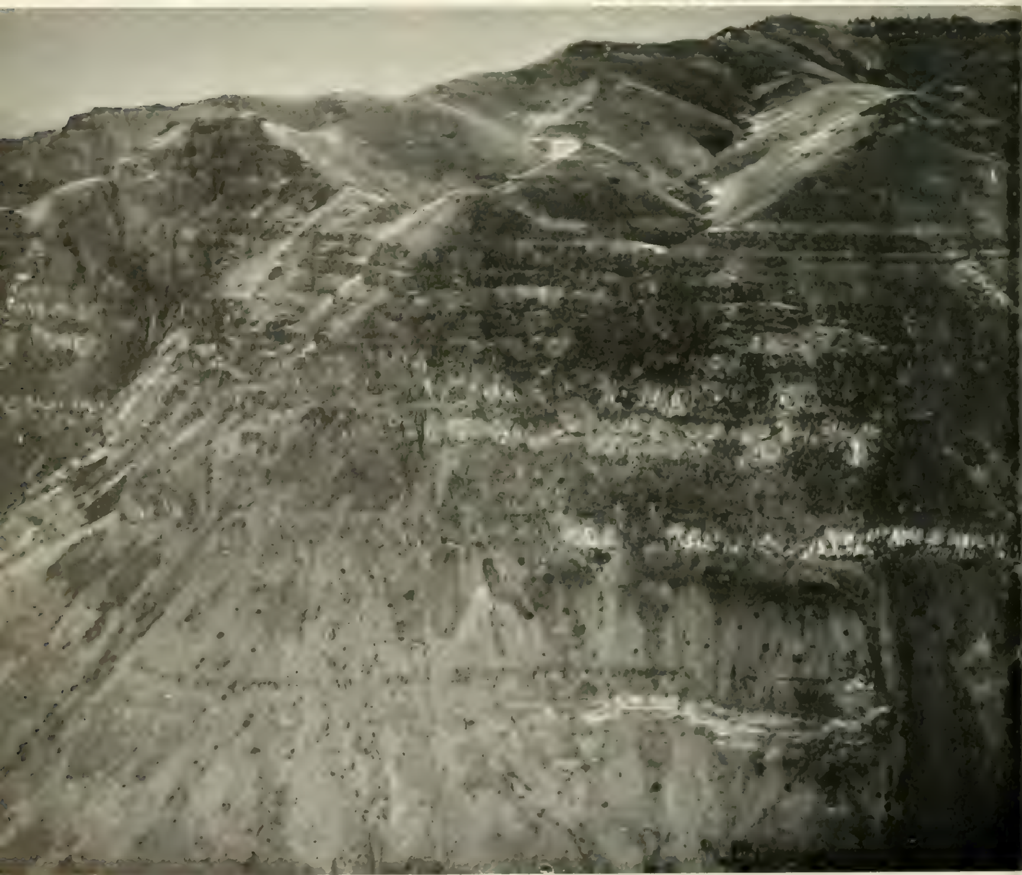


Photo by K. D. Swan reproduced by Courtesy of the U. S. Forest Service

3

smaller ones at least, ran in either a northerly or southerly direction. As a result, elongate groups of hills and low mountains rose conspicuously here and there above the broad valleys. No Cascade Range then stood between the Inland Empire and the coast, and at least some of the principal rivers must have cut across the general trend of the country to carry their burden of sediment to the ancient Pacific. This was the old land surface over which the fiery lava floods spread.

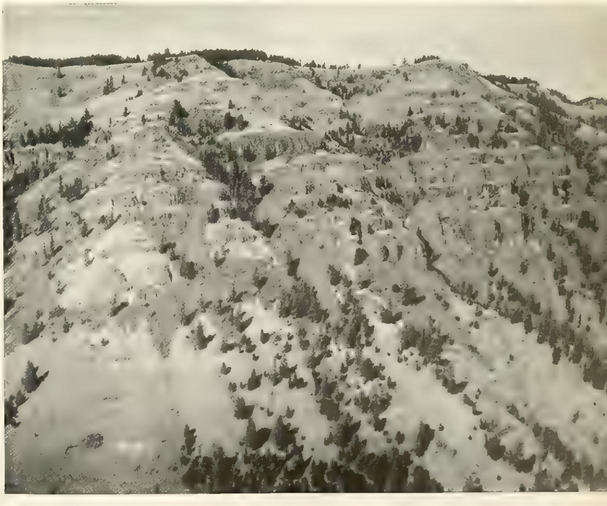
Then, some 20 million years or more ago, deep-seated disturbances began to stir beneath the land that was to become the Inland Empire. Perhaps the crustal movements were urged by the fusion of large volumes of subcrustal rocks, perhaps on the contrary the fusion was caused by the crustal movements. As yet no geologist has determined satisfactorily which happened first. In fact, a fundamental question that is always coming up in such cases is, "Which comes first—the big squirt or the big squeeze?" But as the disturbances became more and more intense, the crustal rocks cracked, and through the cracks welled up the first Columbia River lavas. Not much is known about the distribution of the "feeders" of the lava flows. They are now sealed shut by the last lava that entered them and "froze" to form dikes. Numbers of these dikes can be seen where the rocks concealing them have been worn away, as in deep canyons, but most of them are buried from view beneath the lava

4

As Time Went on, surge after surge of molten rock poured forth and spread far and wide over the Inland Empire. Dozens of these flows, mostly between 50 and 100 feet thick, can be counted in some canyon walls, as in the canyon of Slate Creek at right. This creek dissects a block of more than 50 flows. The top flow, though it looks fairly level in this picture, slopes downward to drop more than 4000 feet in about eight miles.

The lava must have been very liquid, for single flows commonly extended for many miles without much change in thickness. But while the fiery floods spread, their surfaces began in places to crust over as they cooled, and the juicy, rapidly-flowing material beneath continually broke up the crust and churned it along. Thus the whole mass became a jumble of broken fragments, with just enough liquid material to allow it to flow. Then the liquid solidified to bind the broken pieces and form "flow breccia," which is common in the Columbia River lavas

Photo by Courtesy of the Washington National Guard



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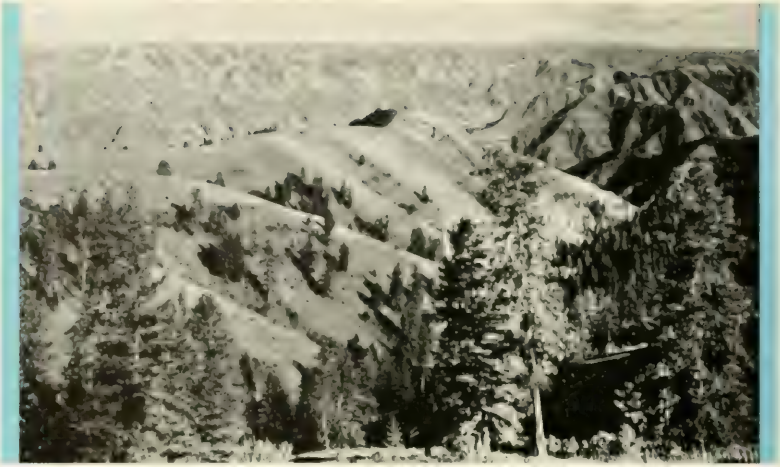

[illegible], reproduced by courtesy of the U. S. Forest Service

(Above) AN IMPOSING EXPANSE in the northeast corner of Oregon. The characteristically level skyline in general marks the top of the youngest lava flow. Rivers have cut fine cross-sections of the flows here

WHEN THE LAVA was forced through the feeders it was charged with gases: water vapor, carbon dioxide, and many others. As the molten rock spread over the land, the pressure on it became much less, and we have an example of what happens when we see the cap removed from a bottle of charged water. Locally, highly charged lava frothed violently, and the bubble walls solidified to form a sponge-like rock called "pumice." In less highly-charged and in more viscous flows the bubbles formed with greater difficulty and rose more slowly, but they were commonly of larger size, and those that were trapped in the solid rock formed vesicles, which give the name "vesicular lava" to that type of rock

STONE THAT FLOATS. The highly porous lava called pumice is lighter than water

WHEN LARGE GAS bubbles formed in the solidifying lava the type known as vesicular was provided

AMNH photos by [illegible]

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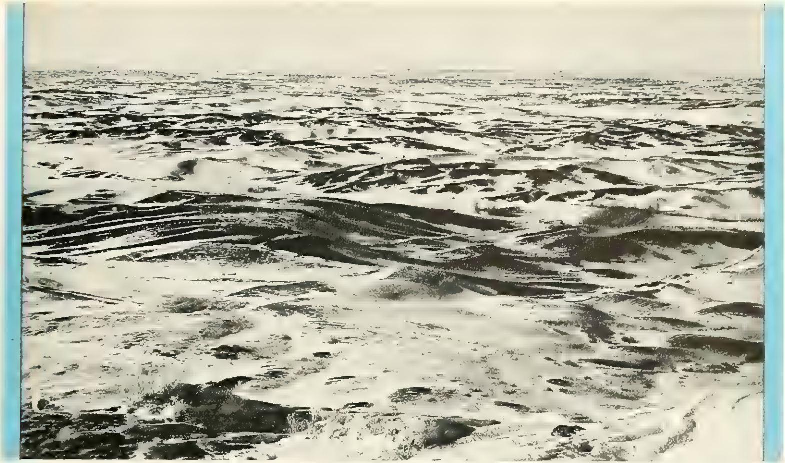

Photo by Courtesy of U. S. Department of Agriculture, Soil Conservation Service

BUT LET US SEE what was happening to the appearance of the Inland Empire as flow after flow poured out upon it. We must realize that it was a broad realm of moderately mountainous country, on which rain fell, streams flowed, and vegetation grew in more or less abundance. The spreading liquid burned everything in its path, as flood after flood poured over the land, filling the valleys, rising to flood the lower hills, and eventually inundating even the uplands over wide areas. Here and there exceptionally high, isolated hills stood above the sea of lava, and to these the name "steptoes" has been given, after the famous Steptoe Butte in eastern Washington. A view from the top of this butte is seen above, a vast expanse on which erosion and the deposition of wind-blown material have produced a landscape that resembles the wave-capped surface of a great sea

SOME LARGER MOUNTAIN GROUPS also were too high to be covered by the fiery liquid. One of these, the Wallowa Range in eastern Oregon, rises in the background in the photograph below. Snake River, in excavating Hell's Canyon in the foreground, has cut through the lava flows and exposed splintery-looking masses of older rocks which were once hills but which were buried in the flood.

On three sides the flows sought their own level against outlying higher land, but just how they ended toward the west is not so well known. Possibly they simply spread until they were stopped by their own cooling

Photo by Courtesy of the U. S. Department of the Interior, Geological Survey

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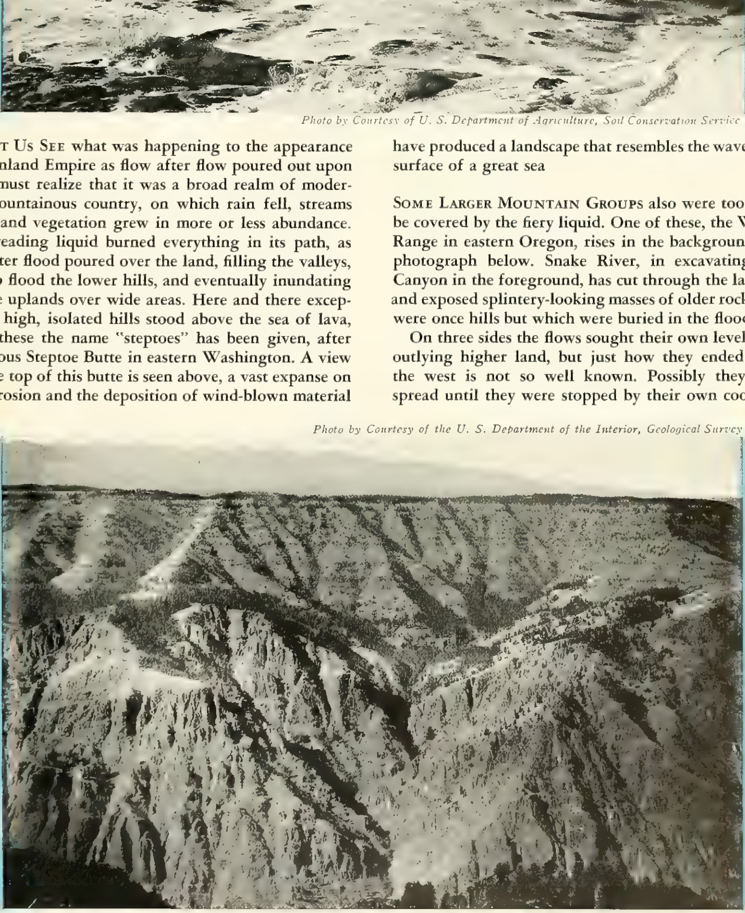

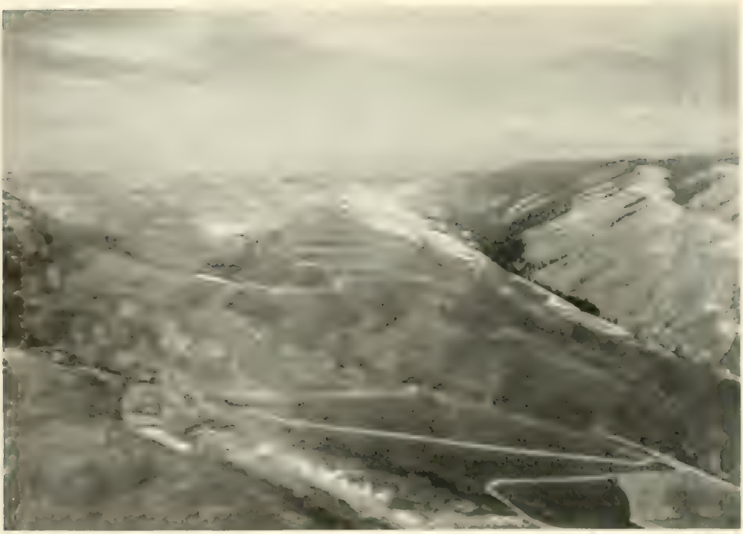

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A COMMON and widespread result of the floods was the interruption of established drainage courses. Streams were dammed, and large and small lakes were thus formed, particularly along the mountain fronts in Idaho. Into such lakes the streams carried sediment and leaves, logs, fruit, and other vegetable débris. Today the geologist finds these plant remains and learns from them something of the climate of the time. Strangely enough the trees were largely of the deciduous kind, not the conifers of the same region today. Maple, oak, birch, ginkgo, and sycamore are found, also a species of sequoia, a forerunner of the giant living redwoods.

Streams were dammed not once but many times, and enough time passed between the outpouring of many of the flows for the drainage to be re-established, soil to form, and forests to grow and mature.

Thousands of cubic miles of molten rock could not be removed from beneath the surface without causing the earth's crust to yield. So the Columbia plateaus settled, perhaps 2000 or even 3000 feet. In fact in some places the base of the lava is today below sea level. And while the center of the Inland Empire was sinking, the edges were being lifted up. Perhaps much of the lava came from under the mountains that now border the lava plateaus, and in that case the mountains may have been lightened enough to cause them to "seesaw" up to reach what is known to geologists as "isostatic balance."

At this time also the great Cascade Range was rising and carrying up with it the overlapping flows.

Locally over the plateau large blocks rose and settled independently, and where the lava could not bend it broke, producing great faults. The photograph above shows where the Whitebird Grade zigzags down the face of a great tear in the lava caused by movement of adjacent blocks, between Grangeville on the plateau of Camas Prairie and Whitebird. This great slope has evoked a gasp of wonder from many a tourist as he suddenly starts down it, and some of the best fossil leaves come from lake beds that crop out along this road

9

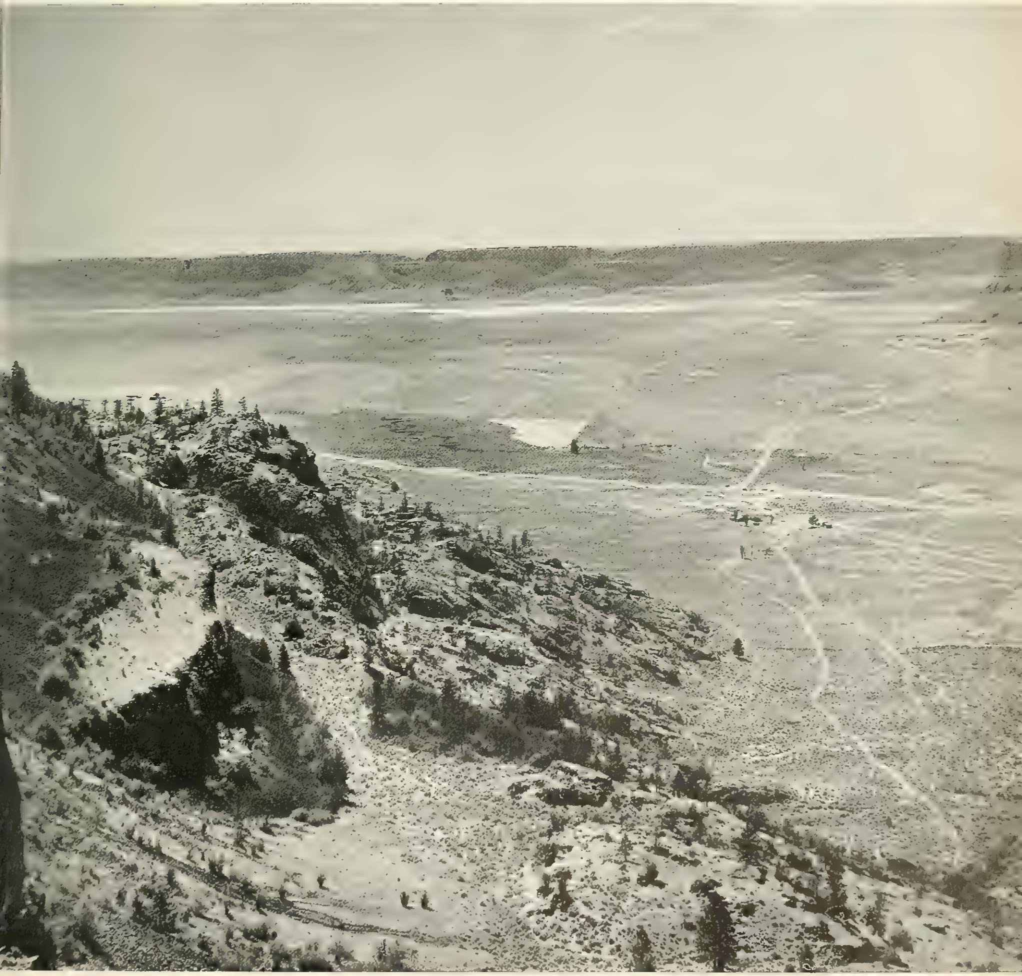
THE LAVA FLOODS had forced the Columbia River far north of its old channel, causing it to flow near the northern limits of the Inland Empire. And since there was no Cascade Range, the Columbia flowed right from the lava plain to the ocean. Then, as now, this mighty stream and its tributaries drained practically all of the Inland Empire.

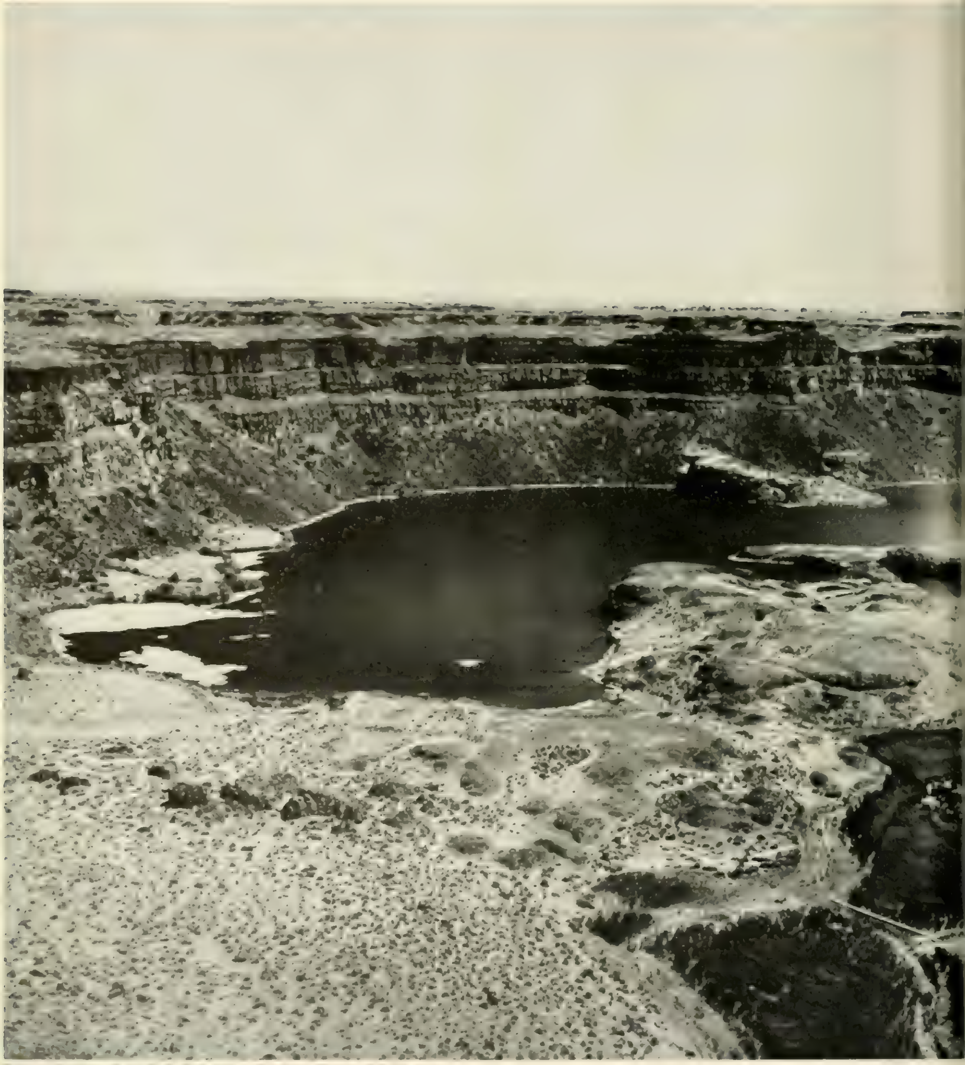
As the crust began slowly to bend upward to form the majestic Cascades, the westward flow of the river was impeded. Had the uplift been faster than it was, the river might have been dammed completely and a huge lake would have been formed; but the cutting power of the stream was too great, and the river was able to gouge its channel faster than the crust was uplifted. Thus came into being the noble gorge of the Columbia through which the river still flows on its way to Portland and on to the Pacific Ocean

WITH the dawn of the Quaternary period about two million years ago, the whole earth began to feel the effect of changing climates. The polar icecaps expanded, and alpine glaciation began in mountain ranges much nearer the equator than formerly. Eventually a great glacier pushed down the Okanogan Valley and spread out in a broad sheet upon the northern part of the Inland Empire. And the mighty Columbia, throughout a part of its course in central Washington, was shoved relentlessly southward by the advancing ice, just as it had formerly been crowded northward by the lava floods.

When the ice had shouldered the river as far southward as it could, the stream, swelled in volume by the melting ice, "dug in" and cut for itself a new channel. But when the ice sheet had retreated and exposed once more the old channel of the Columbia, the river triumphantly re-occupied its former course and left the other one high and dry. Thus came into being the Grand Coulee, which is illustrated below. The frowning bluffs in this photograph once looked down upon the chilly, flooded Columbia River of glacial time. The size of the ancient river is brought forcefully home by the magnificent dimensions of this steep-walled valley. The end of Steamboat Rock, once an island in the glacial stream, shows on the right near the middle of the Coulee

Photo by Courtesy of the U. S. Department of Interior, Bureau of Reclamation





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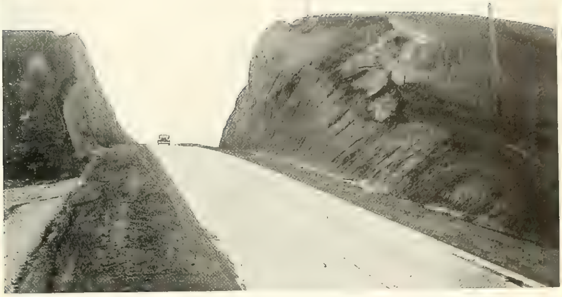
10 A Many-Times Magnified Niagara once plunged over the great cliff illustrated above, when the swollen Columbia poured down into Falls Lake, which remains today at the foot of this horse-shoe cliff in the Grand Coulee



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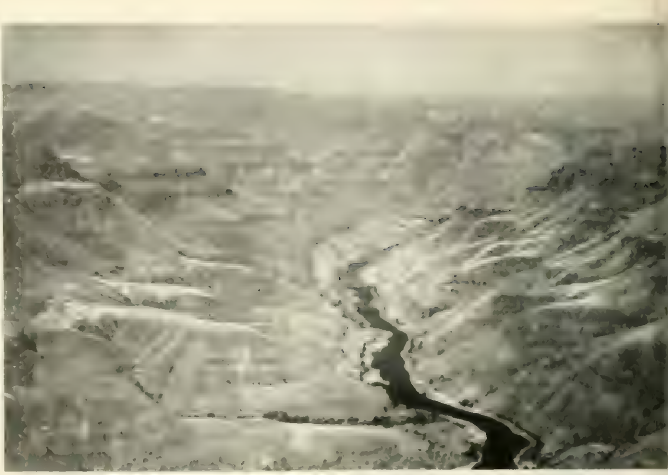
As Shown above, the soil over much of the Inland Empire is many feet thick, and it is the boon of the wheat-growing Palouse country and other sections of the Inland Empire. How this deep soil was formed has long been a subject of debate. One group firmly argues that the soil was formed largely in place, by the weathering and disintegration of the topmost lava. The other holds that it was largely deposited from the air, in which it may have been carried great distances by strong winds. The latter group points to the fineness of the particles and the great quantities of dust that are carried about by strong winds today.

But other parts of the great Inland Empire have practically no soil at all and are called "scablands." There the surface is in many places virtually as bare as a billiard ball. Was there ever soil over these parts? Was it removed by wind or running water as rapidly as it formed? Especially east and southeast of the Grand Coulee the scablands are complexly scored by channels that must be old water courses. But the complete explanation is not yet known

12

The Soil of the Inland Empire is rich. The semi-aridity of the area prevents large parts of the plateaus of the Columbia from being intensely cultivated; nevertheless wheat grown in the Inland Empire amounts to nearly 50 million bushels a year *(see photograph below)*

Photos by Courtesy of the U. S. Department of Agriculture, Soil Conservation Service



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This brings us to the last and shortest chapter of our story, which belongs to man and to what he is attempting in this great empire. Human endeavor has already yielded rich returns. This far-flung mountain and desert-bordered land even now supports a sizable population of sturdy Americans in spite of the long, dry summers, during which the water problem is in the minds of all. Scarcity of water might seem surprising in a region crossed by such great rivers as the Clearwater, Salmon, Snake, and Columbia. But the reason is plain. Most of the streams are fed from the highlands bordering the plateaus and flow throughout most of their courses in deep, steep-walled canyons. Irrigation is therefore frequently impossible except in the lower parts of the valleys, as is apparent in the photograph at right. This shows the valley of the Salmon River near Grangeville, Idaho, where the river, in carving its valley, has left a well-developed, step-like terrace on each side. These terraces resulted when the river was able to cut a wider valley than it has succeeded in doing at its present level. Its task in doing this may have been simplified by the presence of one of the relatively soft lake beds that are abundant between the layers of lava in this vicinity

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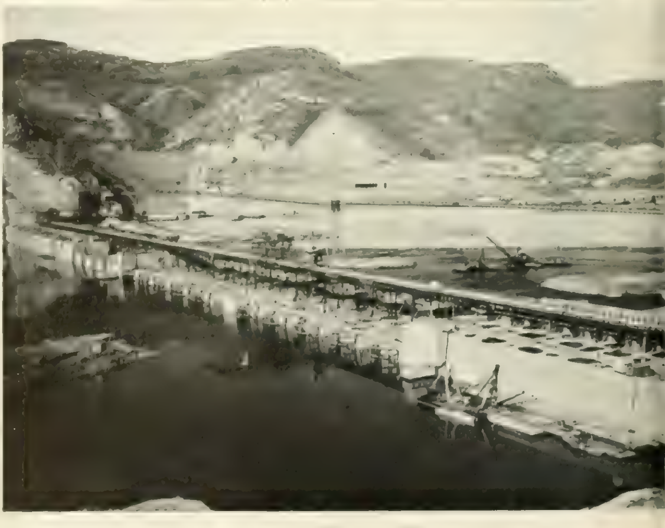
BUT THE VISION of our modern empire-builders is broad. Streams once blocked by seething lava or glacial ice can also be dammed by man. Power can be developed on a vast scale, great storage reservoirs can be provided, and township after township irrigated. Already we have Bonneville Dam across the Columbia in its deep gorge through the Cascades. And farther upstream the much vaster Grand Coulee Dam project is well along toward completion, as shown in the photograph at right. Here is being built the largest man-made structure ever conceived. At this point the Columbia River has carved through a relatively thin cover of lava flows and filed its way deep down into an underlying granitic hill. The flows are the dark, horizontally-banded rocks near the hill top, whereas the granite is as light as the concrete of the nearly-completed dam.

The great valley will be flooded 150 miles to the Canadian border. Giant turbines will convert river energy into electric power, a fraction of which will be used to pump river water nearly 300 feet above the reservoir level into the Grand Coulee, where it will again be impounded in a reservoir nearly 20 miles long. From this higher reservoir the water will be distributed for irrigation over the broad, parched area southward toward Pasco on the Snake River.

Thus ends the story of the Inland Empire. We have traced its history from the dim geologic past to the present. Many events have been recorded in its rocks and landscape since the first fiery floods welled out over its primordial surface. Even stranger things may happen in the future as man learns to control more and more of nature's processes

14



GEM FOR APRIL

The diamond, unrivaled for its enduring hardness, is bright in beauty and soft in sentiment

By FREDERICK H. POUGH
Assistant Curator, Geology and Mineralogy, The American Museum of Natural History

LEAST traditional of all the birthstones is that selected for April, because the diamond was probably not known to the ancients. It first appears as a birthstone in the revised breastplate of the early eighteenth century Poles, substituted for sapphire. By then, of course, the singular qualities of the diamond were well understood and impressed upon the minds of all, even though the stone had been invested with mystery for many years. It was so hard it could not be worked, and the Hindus (who first had the stones in any quantity) cleaved out flat flakes which then were set in jewelry, often with colored foil beneath them. It was not until many years later that it occurred to anyone that diamond itself could be used to cut diamond, and we then see for the first time some of the beauty of this unique stone.

The name is derived from Greek *adamas*, which means "the unconquerable," and was given because of the diamond's resistance to any kind of abrasion. A myth asserted that diamond could not even be crushed upon an anvil, so hard was it—a severe experiment for any gems which were so tested. For this hardest of all stones has an excellent cleavage and can be crushed as readily as many other stones. Later the belief arose that stones became soft and workable only after being dipped in fresh goat's blood.

Diamonds are composed of pure carbon. Though carbon is a light element, diamonds are relatively heavy, because the carbon molecules are so closely packed in the crystal network that they weigh more, just as a box full of sand weighs more than the same box filled with agate marbles. This form of pure carbon is colorless, when truly pure, but, like so many gems, very minor traces of impurity tinge the gem with color. Diamonds, which are among the commoner gems (the engaged couples of the world could not all be supplied with any other of the more precious stones), have been classified according to color. A fine white, with perhaps a tinge of blue, is regarded as most desirable, with yellow shades subtracting from the cost. When the coloration is attractive and becomes intense—rose perhaps, canary yellow, green, blue, or rarest of all, ruby-red—, the rarity and value are enormously increased.

Once the only source of diamonds was India, and many strange tales arose about the hiding place of these remarkable gems which filtered through to Europe. A common story, recounted in another version in Sindbad, is of a wonderful but unapproachable valley, the floor of which was studded with loose crystals. Pieces of meat tossed into the valley tempted eagles, who unwittingly carried the adhering crystals to their nests, from which they were gathered by intrepid, or terrified, explorers. It would be interesting to trace the origin of this myth, which is related in many versions in many lands.

The 125-carat Jonker I

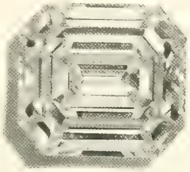


Photo by Courtesy of Harry Winston

The President Vargas diamond, a handful of the world's hardest material. Scheduled for cutting this month

Photo by the author

When the Indian deposits were becoming exhausted, new finds were made in Brazil, and for many years Brazilian stones supplied the entire civilized world. Discovered in 1729, the Brazilian deposits, which are principally in stream gravels were operated at first by the Portuguese Government with slave labor, during which time a few important stones were found. The discovery of the South African deposits struck a blow to the Brazilian workings, but recent work has been more intense, and several large stones have been found in Brazil in the last few years. The largest, now known as the "President Vargas," weighs 726.6 carats and is slightly heavier than the recently found Jonker from South Africa.

The South African deposits were found to be of importance around 1870. They soon superseded all the other known deposits and have continued to be the principal producers down to this day. The United States has one diamond "pipe" (in Arkansas) which has produced stones of excellent quality, but it is little exploited at present.

Most of the myths connected with the diamond arise from its hardness. There was a belief that it would break the teeth if it were put into the mouth or rupture the intestine if swallowed. A flawed stone was believed to bring misfortune; and the shape of an uncut diamond was thought to be of significance. A triangular stone was said to cause quarrels, a four-sided stone to cause vague terrors, and a five-sided stone to bring death. Only a complete, six-pointed octahedron was lucky. Swallowing of diamond dust was supposed to be fatal, and the celebrated artist Cellini reports that he once escaped death only because of the fraudulent use of citrine quartz for diamond by someone who had been ordered to prepare such a fatal dose for him.

More modern legends attribute good fortune to the wearing of the diamond. To him who wears this stone come strength, fortitude, courage, and hence victory, and power to resist the devil and keep away nocturnal specters. However, as one author sagely suggests, diamonds were not too safe to own even though they rendered the owner fearless, for it was sometimes healthier and more conducive to longevity to have a little fear.

ANGKOR

THE LOST KINGDOM OF THE KHMERS

By TRUMAN BAILEY

[illegible]
from Three Lions

Deep in the jungles of Indo-China, women fought beside men in the war that resulted in the ruin of one of the most spectacular and mysterious empires of the past. Today the drums of war sound once more near this historic site

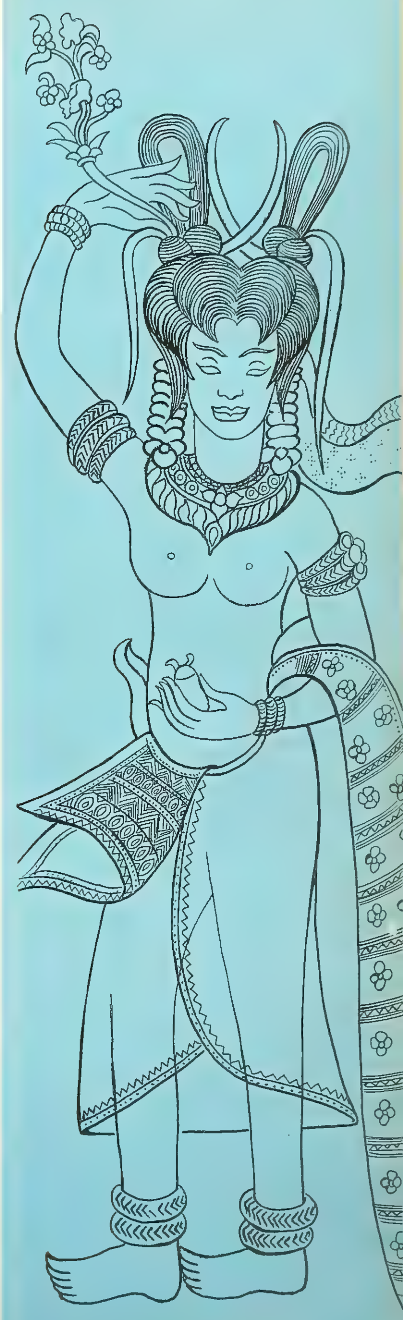
ACCUSTOMED as we are to hearing the story of civilization told against the background of Greece and Rome and Egypt, we are apt to lose sight of other glories of the ancient world. One of the most spectacular and mysterious empires of the past is the vanished kingdom of the Khmers. Located in dense jungle in southeastern Asia, its ruins tell their own version of the age-old cycle of conquest and decay, in a region on which the spotlight of international strife has recently once again been turned.

Three hundred miles northwest of the port of Saïgon in French Indo-China and approximately 100 miles from the frontier of Siam, or Thailand, stands the ancient capital of the Khmer Empire, a city enclosing an area of five and one-half square miles. This vast metropolis, Angkor Thom, has been described as being richer in architecture than fabulous Babylon at the time of Nebuchadnezzar, and more powerful than Carthage at the time of Hannibal. The towers of the temple, Angkor Wat, rose as high over the teeming city as those of the cathedral of Notre Dame. And conservative estimates have indicated that over a million persons once occupied the capital. All of which only heightens the haunting mystery of why the powerful and highly cultured people deserted their well-ordered metropolis. What happened to them?

For centuries before its real discovery, reports of the ancient kingdom were regarded by Europeans as too fantastic to be believed. As early as the seventh century, Cambodia is mentioned in the literature of China; and a precise, factual diary of the people and their habits during the year 1295, at the peak of their civilization, was recorded by a Chinese ambassador to the royal court at Angkor.

The fascinating story of Angkor first attracted wide public interest in the Western World when Henry Mouhot, a daring French naturalist, searching for rare plants and accompanied by only a handful of native guides, penetrated deep into the jungle of Indo-China and came upon the breath-taking ruins of the mysterious ancient city. His glowing description of what he had seen, published in the *Tour du Monde* in 1861, electrified the French Government into action, and no time was lost in gaining jurisdiction over the important site. Already settled in Indo-China, the French Government established a protectorate over Cambodia and started the momentous work of excavating Angkor from the jungle that had engulfed it for five centuries.

The important prize won immediate acclaim from the archaeologists who hastened to the scene. Just where the Khmer people came from remains in doubt, but there are many things to suggest that they had a spiritual and cultural bond with India. They were presumably ruthless conquerors, and were actively engaged in conquest and aggrandizement from at least the sixth century to the thirteenth. Early in the ninth century, under Yaçovarman II (a Javanese, probably from Sumatra), they founded Angkor, which means "The Capital," and the basis of their supremacy in Cambodia was established. Settled in this seemingly impregnable stronghold near Tonlé Sap ("The Great Lake"), they ruled through the ensuing centuries, and the trumpeting of their fearsome, armored battle elephants echoed over all this southeastern portion of



[illegible] added to their [illegible] along the Mekong River, [illegible] from the Prom [illegible] Mountains to the [illegible] gods, and [illegible]

The [illegible] Per-version and easy living softened the sturdy fiber of the race, and greedy princes started plotting among [illegible] of the [illegible] peoples of Thailand to the west was rising, and the Annamese to the east were gaining strength. Raiding parties swept out of the jungle in sudden forays. Surprised at their successes, these parties grew in size until huge well-equipped, well-trained armies were thundering at the city gates. The power of the Khmers, divided within, made its last stand with women fighting shoulder to shoulder by the men in an attempt to repel the invaders. But the end was inevitable, and finally the power of the once invincible nation was shattered.

Unrelenting, the attackers attempted to destroy every vestige of the hated civilization. But the Khmers had built well, and the solidly-placed standstone resisted their efforts. The invaders were forced to content themselves with bashing in the faces of the sacred statues, toppling over walls, and tossing hated idols down deep wells, from which they are to this day being recovered.

The Khmers, completely shattered, sought the protective wall of the jungle and settled first by the shores of the great lake. To the south and east of it on the banks of the Mekong they established a new capital at Pnom Penh, in the fifteenth century. But owing to frequent invasions by the Siamese from the west and the Annamese from the east, the unhappy kingdom was reduced to a complete shambles.

TODAY TWO ROUTES take the enterprising traveler to the ruins of Angkor. One, from the seaport of Saigon, makes use of bus, river boat, or hired motorcar. The other, from Bangkok, follows the railroad through the otherwise impassable jungle to Aranya on the Siamese-Cambodian border, thence by motorcar to Angkor

ONCE one of the world's great capitals. Possibly the last prince of the Khmer Empire looked out upon the ruins of his city much as the modern native is doing in the photograph at right

S I A M
(T H A I L A N D)
F R E N C H
I N D O
C H I N A
C A M B O D I A

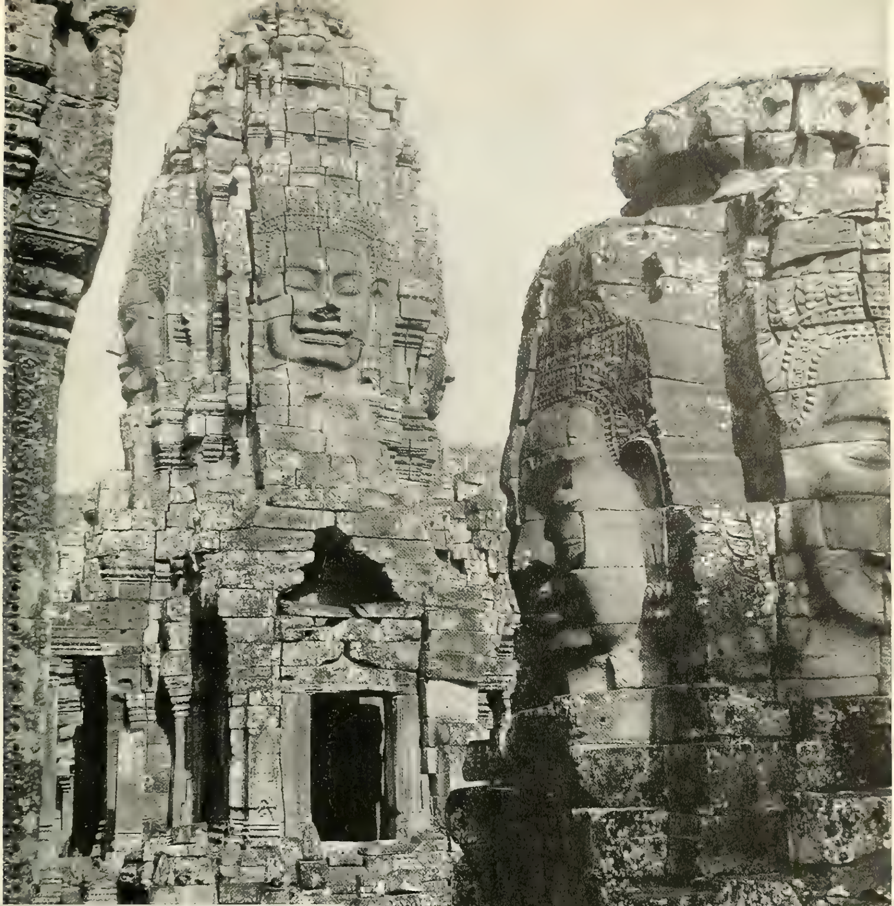
(Right) THE PLANT WORLD TRIUMPHANT over the works of man. We can imagine the sensations which must have stirred Henry Mouhot, the French naturalist who brought the ruins to public attention in 1861, when he came upon them buried beneath the vegetation of centuries. In the steaming jungle, vegetation grows almost as fast as it can be cut away; and though men are battling on many fronts to preserve the buildings, sufficient funds are not available to win a decisive victory

(Left) TODAY, as the visitor approaches and the forest opens up revealing the Bayon, the first impression is of a great pile of reddish-gray sandstone almost totally lacking in organization

(Left) BUT as a closer view is obtained the great pile of sandstone resolves itself into a shimmering mass of gigantic faces. The deadly silence which hangs over this ghostlike scene, where once the sound of voices filled the air, makes it an uncanny experience to behold these giant relics of a vanished glory

(Below left) THE VICTORY GATE is one of five gates which led to the town of Angkor Thom through the great protecting wall, which still stands. Each gate is 65 feet high and culminates in four human heads, said to be of the Hindu deity Siva, facing the four points of the compass. Through these gates filed the hosts of the Khmers, returning from their raids over the far-flung Indo-Chinese peninsula.

The royal city of Angkor Thom was founded in the ninth century. Surrounded by a moat 328 feet wide, and a wall 30 feet high, the enclosure of three and one-half square miles ultimately proved too small for the growing metropolis. The city spread until it sprawled over an area of at least 20 square miles. The living quarters of the people, which have seldom been mentioned, were doubtless built of wood and added greatly to the impressiveness of the city, though they have long since disappeared



(Left and above) One hundred and seventy-five of these gigantic human faces, six and a half feet from brow to chin, appear on the towers of the Bayon. This temple represents the flourishing period around the end of the twelfth century. The faces were first conceived as a compliment to the Bodhisattva Lokeśvara, but the temple was later dedicated to Siva. These sculptures, which represent an enormous amount of physical labor as well as artistic skill, reveal a civilization in which religious motives were dominant

THE ARCHITECTURAL GENIUS of the race of people who built Angkor Thom found its fullest expression in Angkor Wat, the temple of the capital (*above*). Rising 215 feet above the plain, it stands today the best preserved of all the Angkor monuments. A faultless organization of mass, it was designed to impress pilgrims who came to worship at this sanctuary of Vishnu, whose statue rests beneath the dome of the central tower

(Top, right) THE TEMPLE OF ANGKOR WAT, like all the other buildings at Angkor, was laid out on the points of the compass. But Angkor Wat faces west, instead of east, to accommodate the countless pilgrims approaching by a road which passed along its western side. A rectangular moat over three miles long enclosed the great building, across which runs a causeway paved with laterite resting on stone foundations four and one-half feet thick. This makes an avenue 225 yards long, bordered on each side by a parapet representing a serpent, a portion of which may be seen in the accompanying photograph.

King Suryavarman II, who built the temple to Vishnu, god of preservation, saw to it that his own likeness appeared frequently in its epic carvings. Khmer history is depicted on the sculptured panels, one of which is almost half a mile long

(Right) THIS GREAT AVENUE, elsewhere in Angkor, was demolished by the invaders, but an effort has been made to replace the existing parts. We are told by the Chinese ambassador Tcheou Ta-Kouan that 54 genii supported the giant Naga, or serpent, bordering the roadway. This would make a total of 108 statues to each avenue, which is still considered a sacred number in parts of far-off India and Tibet

[illegible]

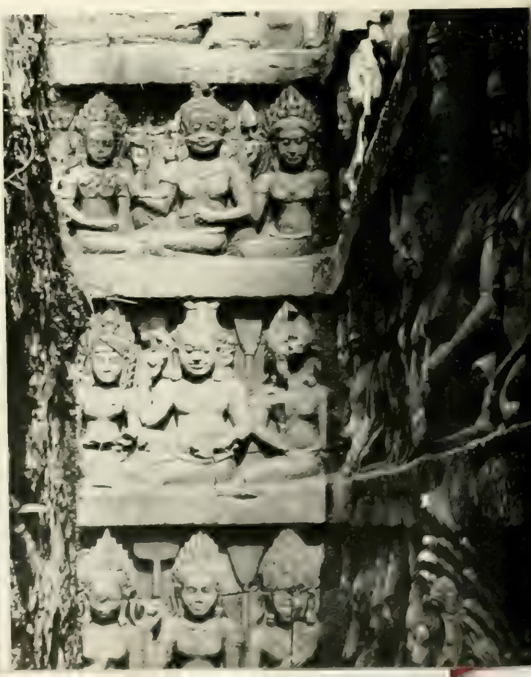
Experts conclude that the Khmers were skillful woodworkers who adapted their technique to stone. The huge blocks were quarried from the Pnom Culen Mountains, 25 miles northeast of the capital. From there they were rafted down the river to the great lake and dragged overland with wooden winches by slaves. The buildings are built upon a mound of solid stone laid very close together in interlocking fashion, without use of cement.

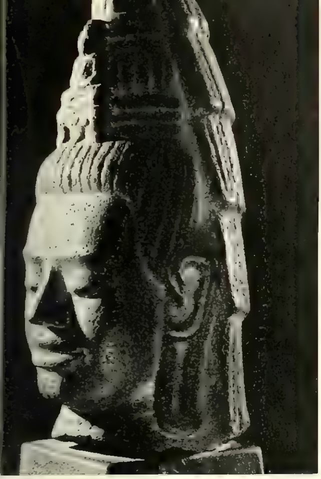
The architects created superb entranceways like that at left, and there is evidence that doors once swung in the frames, though the wooden parts have been stolen or have rotted away. Adept at smelting, they used much iron, and the tools and weapons found are almost identical with those in use among the modern inhabitants. Towers like the one shown here were doubtless gilded, as there is still evidence of a yellowish crust. Furthermore, the Chinese ambassador to Angkor at the end of the thirteenth century mentions its "towers of gold."

As each succeeding flight of stairs mounts heavenward at Angkor Wat the pitch becomes steeper and the flight longer

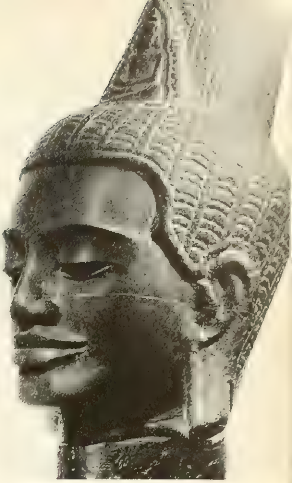
(Below) The joyous "Terrace of the Leper King," whose designation is of unknown origin, is a zigzagging passage, open to the sky above. Today countless monkeys chatter in the treetops and brilliantly plumaged birds flutter about, scolding when they are disturbed. As the visitor, moving silently on the matted greenery, explores this lost kingdom, an indescribable sense of excitement takes possession of him, as though he had been thrust into an imaginary world created by the pen of Rider Haggard

(Below) The deities which line the inner passage of the terrace represent all manner of attendants to the king, including jugglers and sword swallowers

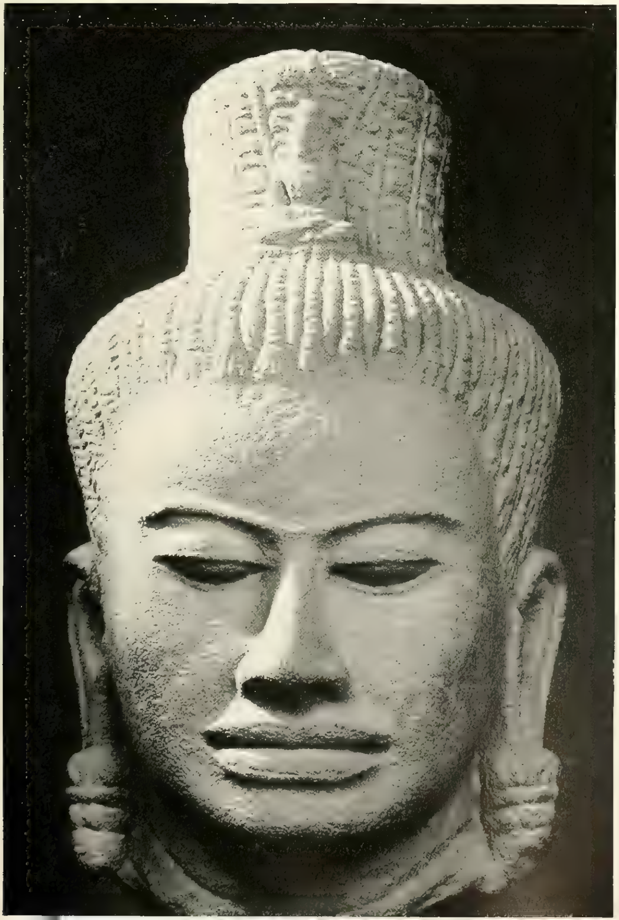




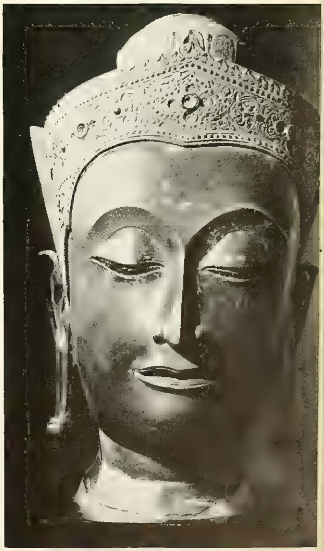
(Left) A NINTH CENTURY KHMER FIGURE from the Angkor region: the head of a devata

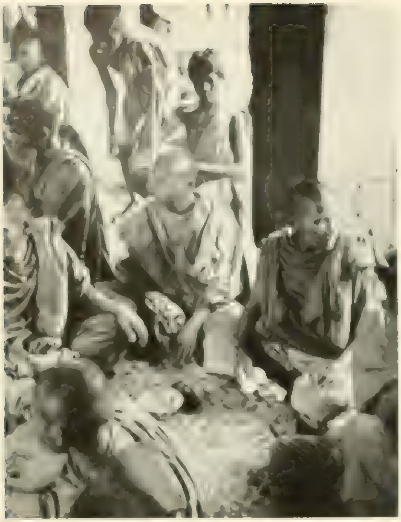


(Right and below) TWO EXAMPLES of twelfth century Khmer sculpture from Angkor: heads of bodhisattvas



(Below) A POST-KHMER BUDDHA of the fifteenth century, from Ayuthia in Thailand, 220 miles northwest of Angkor

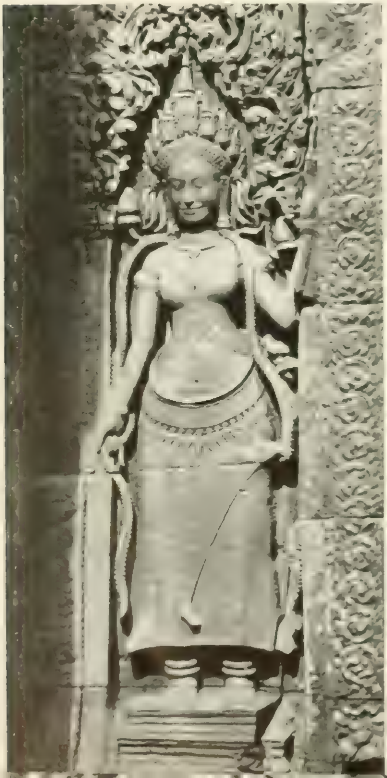




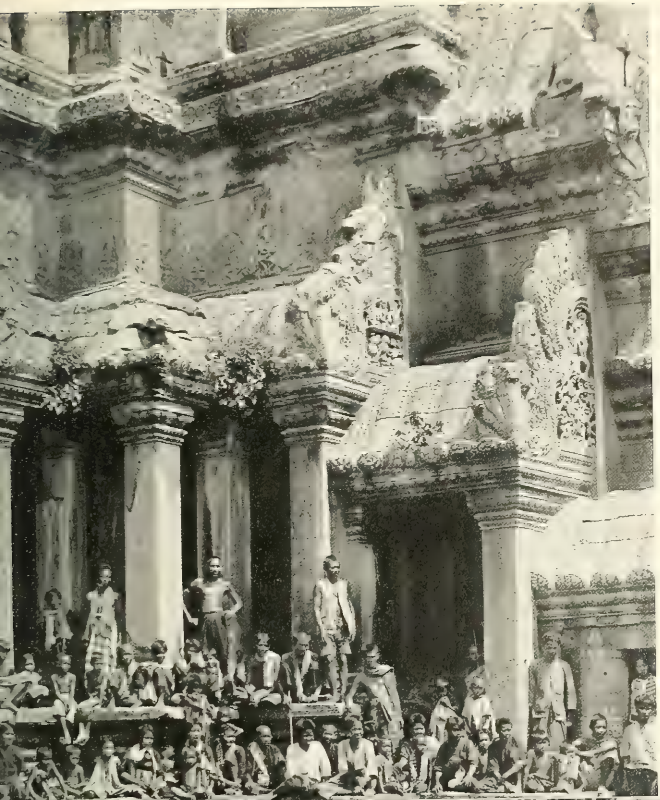
(Left) THE ONLY PEOPLE now actually living in the ruins of Angkor are mendicant Buddhist priests, who have a monastery within the precincts.

The purest form of Buddhism became corrupted as it spread through the Orient. In Cambodia today a doctrine known as the Hinayana, or "little vehicle," is currently popular. But in ancient Angkor, the Mahayana, or "great vehicle," was in vogue.

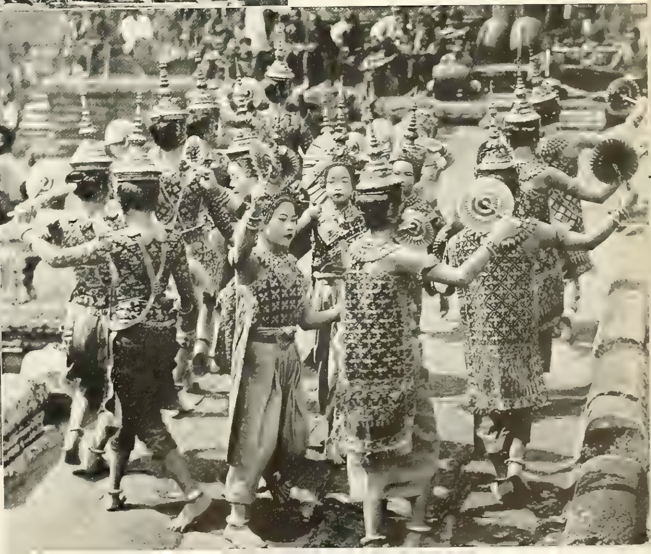
(Left, below) AT EVERY TURN the visitor is greeted by lovely maidens, devatas and Apsarases, Buddhist divinities who smile, dance, and offer flowers.



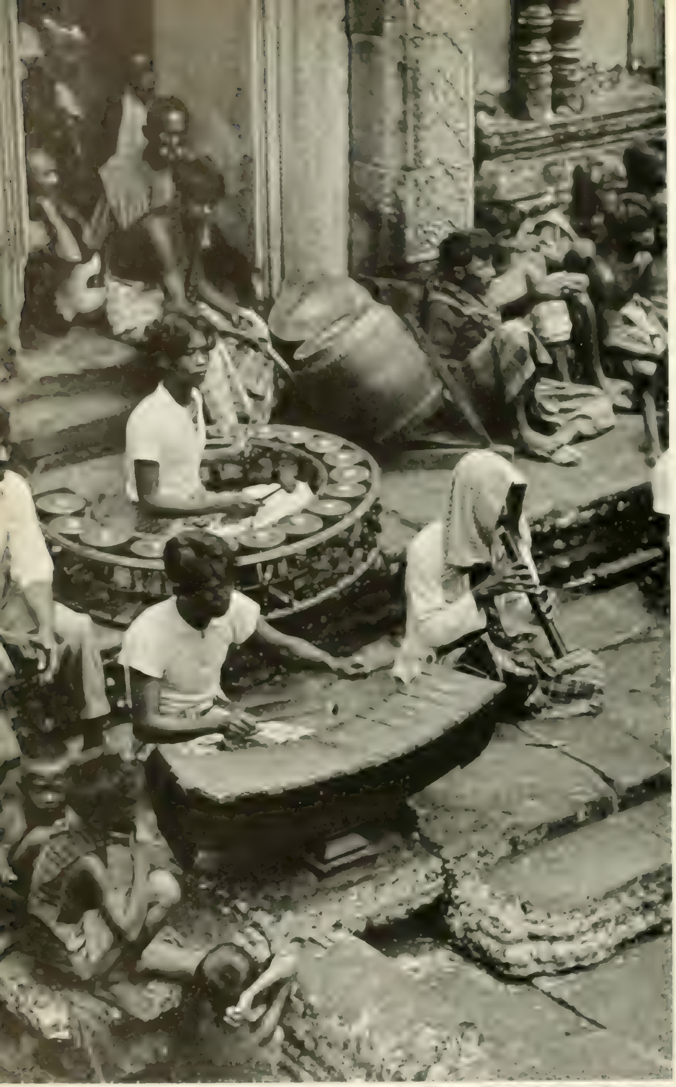
THESE many divinities are ladies in waiting to the gods and make Angkor Wat a corner of Vishnu's heaven.



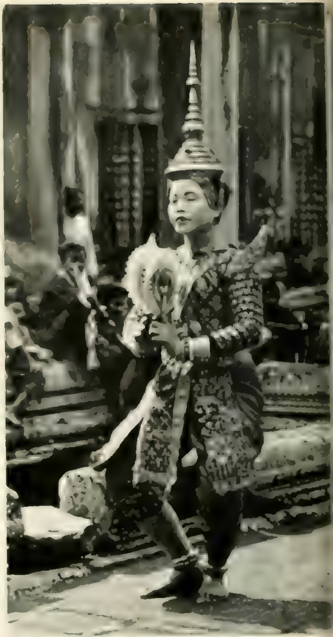
Yesterday and today on the site of the Khmer Empire

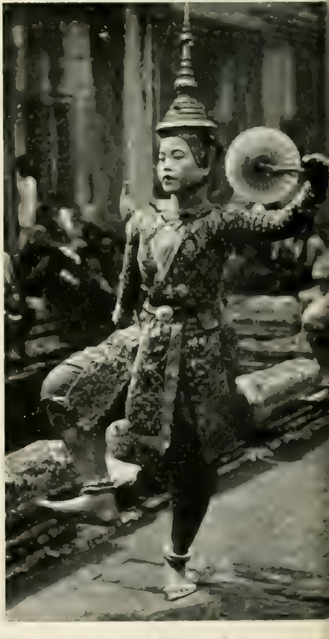


A dance troupe belonging to the retinue of His Majesty, the King of Cambodia, preserves the intricate steps of the symbolic dances of the country of the Khmers. The dances, most of which depict legends of religious origin, were taken by the moderns from the ancient Khmers, and through the years they have retained a remarkable purity. Here the modern scene merges with the ancient, as the Royal Troupe performs the movement against the background of Angkor's sculpture



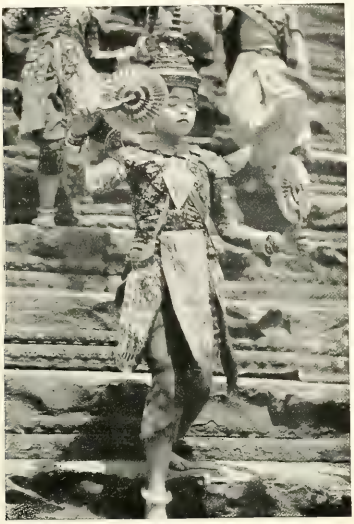
THE MUSICIANS *(above)* follow no written score. The theme has been handed down from generation to generation, and the players may improvise at will. Gongs, drums, and a reedy flute are favored instruments. Rice paste gives the drums a higher note, and they are played by tapping and rubbing

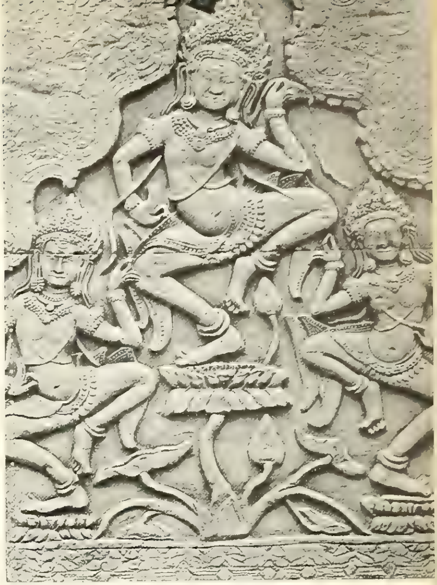




(Right) THE DANCERS balance their weight firmly on their bare feet, rarely on their toes, and the graceful postures of their hands and feet resemble closely those in many of the ancient sculptures. These action photographs were not posed but were part of the continuous ballet. Though the Cambodian ballet is sometimes slow of tempo, the postures frequently follow each other in such rapid succession that the effect is like the fluttering of a bird

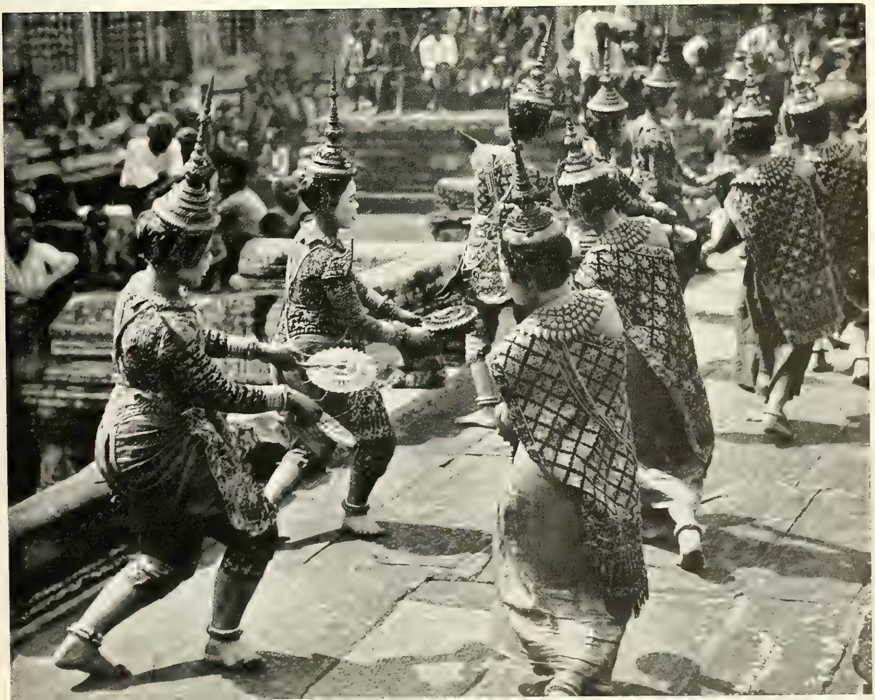
(Below) THE DANCE OF THE FANS is centuries old. Rarely, however, in modern times is the native ballet witnessed actually within the ancient temple, for the troupe generally performs publicly on the outside

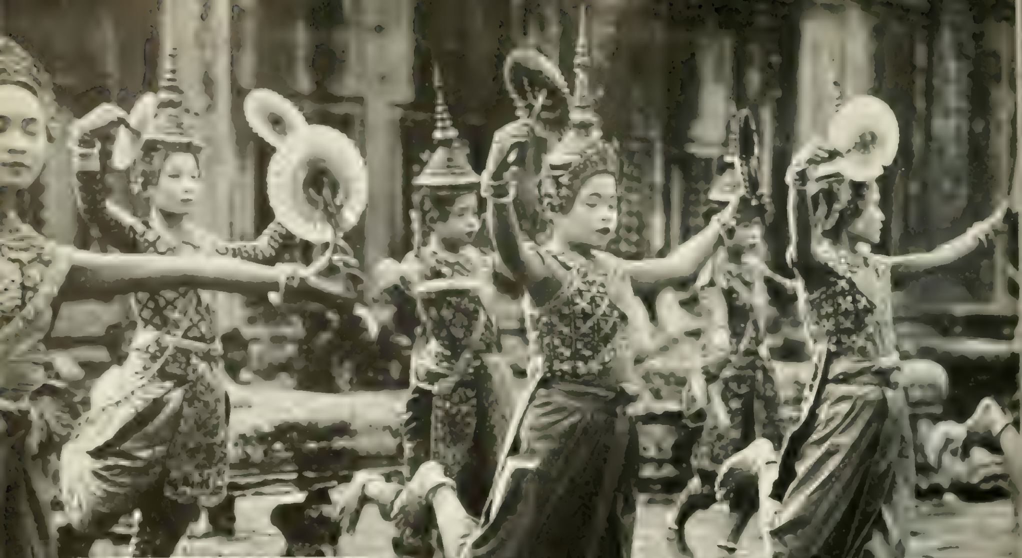




(Above) THE CARVINGS on the walls show dancers in poses similar to those followed today

THE PERFORMERS are exclusively girls, but men are indicated by knee-length breeches and other distinctions in costume





(Above) THE FACES of the dancers are heavily coated with thick white powder, their eyebrows penciled, and their lips painted a brilliant red. Centuries ago, Tcheou Ta-Kouan wrote in his famous diary, "Among women of the nobility you will find persons white as jade," an appearance probably resulting from this same practice

(Left) THE HANDS of the dancers are employed to create an infinite variety of lovely patterns

[illegible]

(Right) THE COSTUMES are painstakingly made and are highly valued. Dull reds, yellows, purples, and greens predominate in a low key, through which is interwoven a rich pattern of gold. The jewelry is gold, heavy and studded with uncut gems. The headpiece is papier-mâché, gold-leafed and set with gems or glass of proper color.

Thus against the background of their ancient monument, the people of Cambodia preserve some of the living art of the mysterious Kingdom of the Khmers

THIS ROBIN OF MINE—*From some place south he gypsies along, giving his cheery morning salute, and as if by magic each spring he finds his way to my back yard, making it a robin resort full of robin affairs*

By ROY L. ABBOTT
Professor of Biology,
Iowa State Teachers College

I CALL HIM my robin because each year for the past five he has suddenly bounced into my tiny back yard about the middle of April, to remain with me till September. I know him to be my robin because of a shiny copper band around his leg with which I presented him when he blundered into a sparrow trap the first year of his arrival, and better yet by the fact that he is a freak in color. Half of his tail feathers are white.

I believe that he knows me, too. At any rate, from the very moment of his coming he shows no fear. The four or five other males who usually arrive with him keep at a respectful distance, but he darts about as certain of himself as if he owned the place. He comes within arm's reach of me to take a proffered worm, gazing at me steadily all the while with his great dark eyes, each of which is so large that it occupies as much head space as his brain. If I had eyes of proportionate size, each of them would weigh two and a half pounds.

Where did he come from? Well, he hasn't told me, of course, but I can safely wager that it was somewhere south of me; and if he is as fond of his winter home as he is of his summer resort, he probably goes back to the same little spot each fall. But whether he spent his first winter in southern United States, Mexico, or only 200 or 300 miles away, he was doubtless born here in Iowa. On that long first journey north, why did he happen to choose my back yard as a nesting place, and how does he manage to find it each year without map or compass? Nobody knows the full answer to those questions, and as I stare at his sleek, well-groomed form, I can only guess. Certainly as I see him this morning, although he arrived only yesterday, he shows no fatigue and no travel stains, nor loss of much of his fat reserve on his probable 1000-mile trip.

But uncommunicative as he is concerning his journeying, men have found out certain things about his doings and those of his fellows, and even I catch onto some of his ways now and then. For one thing, from what I have seen of him and what I have read, he doesn't make all this north-south trip as a nonstop flight as do some of his cousins, the golden plovers, for example, who fly over the sea. With him it's rather a sort of picnic-journey—or maybe I should say, a stag party on the northbound trek, at least, for the males commonly migrate together in the spring. Hence my robin looks clean and well fed this morning, for he started north probably a month ago and has been taking his time about getting here, flying two or three hours at a stretch, perhaps, and then stopping off for food and rest whenever he felt like it. Moreover, in that two or three hours of flight he may not have covered more than 50 or 75 miles, for contrary to popular opinion, my robin doesn't average more than 25 miles an hour while migrating.

Just a few days ago, a small flock of robins—I judged them to be migrating—happened to parallel my path along a country road. They stayed with me for half a mile or more, and during that period the speedometer of my automobile showed almost exactly 25 miles per hour. At various times, also, I have studied mourning doves in the same fashion, and although commonly supposed to be speedsters among the birds, I have never clocked one at more than 50 miles per hour. Audubon believed that mallards average about 80 miles per hour in steady flight and that on occasion they can make 120. But in my judgment, the distinguished naturalist far overestimated their real speed, for a group of high-flying mallards that I pursued in an airplane last year on a windless day could make only 65 miles per hour, and they were obviously terrified and putting out all their power.

Part of the confusion in the popular mind concerning the speed of birds is doubtless due to failure to understand the difference between "air speed" and "ground speed," this last term meaning speed with reference to objects on the ground. Winds, whether the bird is flying with them or against them, make no difference in the air speed of a bird but they make all manner of difference in its ground speed. Suppose, for example, that on a calm day a bird flying at [illegible] In the [illegible] air speed and ground speed are the same [illegible] hour. If [illegible] this same bird flying [illegible] down a [illegible] wind, its air speed is still the same but its ground speed has stepped up to [illegible] miles per hour. Such a bird flying against a 20-mile wind will still have the same air speed but will [illegible] miles per hour ground speed. [illegible] what we should mean [illegible] how fast [illegible]

How did he find his way?

But regardless of his speed or how long he took to get here, the fact remains that my robin is here. And, as I asked a while back, how did he happen to land in my back yard, and how has he managed to find this same little spot year after year?

Perhaps the answer to the first question is simple: my robin just happened to land in my yard, and taking a fancy to his surroundings decided to remain there. But if I knew the full answer to the rest of the query: how did he find his way back to it again the next year, I'd know more than all the students of bird ways have been able to find out. My robin, of course, is not alone in his ability to find his way back to his little summer home; countless species of birds do this every year, and experiments have shown many birds to have an uncanny ability to return to their homes or nesting places even when forcibly carried far into strange country. Thirty years ago, Watson proved the ability of sooty terns to get back to their nests even when transported 1000 miles by water from their normal range. These birds were carried below the deck of a ship and hence could not see where they were going, yet they were back on their nests in five days after their release. Lincoln records that cowbirds banded in Illinois and then released at various widely separated points showed remarkable ability to return to the banding station; also that pintail ducks captured and banded in Louisiana and then released along both the Atlantic and Pacific coasts, were subsequently recovered at the same station or along the Mississippi; also that five out of seven swallows got safely back to Bremen, Germany, after being released near London over 400 miles away. The greater shearwater is a familiar bird to North Atlantic fishermen, but so far as we know, it breeds only on one small island in the South Atlantic, about midway between Africa and South America. Imagine a navigator traveling from the North to the South Atlantic in search of this tiny island without the fullest equipment, yet the shearwaters, equipped with nothing but their natural senses, show no difficulty in finding it.

What then are these "natural senses" that birds use in finding their way back when carried forcibly from their homes or in performing their normal migrations? Many students of bird migration still believe that birds depend largely upon the sense of sight, and that their lines of flight—the so-called "flyways"—are closely associated with the topographical features of the country. In other words, they believe that birds steer their paths by objects on the ground, such as watercourses—things fixed in their memories from a former trip. According to these students, the young birds of the season are led over the route by the older birds, and this first guided trip is supposed to be sufficient to fix in the visual senses of the bird a memory of the migratory path. Interesting as this idea is, however, it breaks down when generally applied, for some birds, such as western sandpipers, do not travel in flocks of old and young together. The young birds do not migrate until about a month later than the parents. These young birds then must have an instinctive sense of direction of the place to be reached, for they have never been over the ground before.

By bird's-eye view?

Birds undoubtedly have wonderful powers of sight, and after once traveling a given route, probably retain many visual memories of its topographical features. But what about those that migrate at night and in dense fog? Murres and other birds are known with certainty to fly unerringly through miles of dense fog, in which an aviator without instruments could not possibly keep an even keel, let alone a straight course. Obviously birds cannot depend upon topographical features to guide them under these circumstances, but it is only fair to say that anyone who has ever traveled at night in an airplane knows that nights are rarely so dark as to obscure all objects upon the ground, particularly rivers and shore lines. Hence birds might easily depend in part upon visual memory while migrating at night. In the case of flying over long stretches of water, however, the situation is entirely different. Because of the earth's curvature, even with eyes that were unlimited in range of vision, a bird flying across the Gulf of Mexico, say at a height of five miles, could then see only about a third of the distance to be traveled.

Therefore it does not seem that my robin's sight alone—for he, too, does some night journeying—or even all five of his senses working in co-operation, would be sufficient to explain how he finds his way to my back yard. In addition to his ordinary senses, there must be something else in that little black head of his—something which for want of a better term I am going to call a "sense of direction." Eyes and ears and his other senses doubtless aid him greatly, but these alone are hardly sufficient to guide him.

But regardless of how he manages to find me each spring, his chief business after getting here seems to consist entirely of three things: to get something to eat, to keep out of harm's way, and to raise a family. He seems particularly bent upon the food-getting business for the first few days after arrival and bounces about my back yard busily filling his belly with earthworms, seemingly unmindful of the several males who came with him. There are still plenty of worms for all, and no female has yet made her appearance.

My robin is an expert at catching these big, slippery worms. I never tire watching him at his hunting. Away he goes, racing like mad for a yard or so on those slender, wire-like legs, finishing his run with a few mighty hops and, at the conclusion of the last one, tipping his head close to the ground as if listening or peering intently. Then a few vigorous pecks, and he has grabbed something. Yes, it's a worm, and my robin sits back on his haunches pulling steadily. There must be nothing hasty about this extraction business, as experience has taught him, else the earthworm, clinging with all its powers by means of bristles which catch on the sides of the tunnel, will break in two. But the worm will tire from a steady pull and give in presently, and my robin seems to know this. There! the worm lets go suddenly, and the puller almost falls over backwards. Then two gulps, the worm is in his crop, and away he bounces in search of another.

Robin schedule

Well, Mrs. Robin, or at least the female destined to become Mrs. Robin, arrived last week, and things have been different in my back yard. For one thing, there are no males other than my robin there now. He saw to that at once. Of course there were some fierce brawls at first, but the other males seemed to feel that my robin had preëmption on the place and soon gave up the struggle. Other later migrating robins drop in occasionally for a bit of food, but my robin sees to it that they don't tarry long. Possibly that is one reason why robins have such a wide nesting range north and south: the earlier birds take up all the nearby places and the later ones are compelled to travel until they find unoccupied territory.

But now that Mrs. Robin is here and all rivals have been driven off, things soon settle down to a regular schedule of robin affairs in my back yard. May 1: my robin decides that the crotch of a big elm is the proper place for a nest, but Mrs. Robin decides differently. She chooses a two-by-four that forms a ledge just inside my garage window, and everyone is satisfied, including myself, for I can watch easily what's going on. May 2: the nest is well under construction. Although it is completed within the next two days it remains empty for yet another day, probably because of its muddy dampness. My robin takes no part in its building, but is seemingly an interested onlooker. Four eggs then appear, one on each successive day. On May 9, with the coming of the last egg, Mrs. Robin settles down to a twelve-day vigil, leaving the nest only long enough to eat. During her absence my robin does not sit on the nest, nor does he feed his mate while she is on the nest—as is the gentlemanly custom of a male rose-breasted grossbeak who is nesting nearby.

Family responsibilities

But my robin is greatly concerned for all that, and when the four tiny young appear on May 21 or thereabouts, he at once takes an active part in feeding them. From a darkened corner inside my garage I spend hours watching this feeding game and I am amazed by what I see. With a good pair of field glasses at such close range I can watch everything that goes on, almost as if I held the nest and birds in my hand. My robin and his mate take turns alighting upon the edge of the nest, each time with some kind of provender in their beaks, and each time they arrive four wide mouths are automatically thrown open to receive the offerings—wireworms, June beetles, crickets, grasshoppers, white grubs, hairy caterpillars and smooth ones, earthworms and centipedes, these, and even other creatures such as snails, all in endless succession from early morning until nearly dark. All four mouths fly open at once, and my robin places his beak with the food far down one of these gaping throats. But he sometimes withdraws his beak, food and all, and offers it to another Hence, I believe Herrick is right when he says that the parent bird always finds out which one of the young is hungry by first placing the food deeply against the inside of its throat. If the youngster is hungry it will make a swallowing action, and if it isn't, it won't. And if it doesn't make the swallowing reflex, the old bird then offers the morsel to a second youngster, sometimes even to a third before getting the proper response.

But such gourmands are they that it is small wonder that a young one (which I weighed) nearly doubled its weight in one day. And in ten days the four were crowding the nest almost to overflowing. Feathers sprouted from their skins like weeds from rich soil. In fact, so rapidly did they transform insects and worms into robin-flesh, they were out of [illegible] in less than two weeks before they're at last out [illegible] around and at the heels of my robin, who now takes practically all the burden of caring for them. For almost before the first brood are able to get about, Mrs. Robin has started a second nest.

Why does he leave me?

So the spring and half the summer for my robin and his mate are largely a continuous round of family cares. They are often terribly agitated by the appearance of a stealthy cat or dog, and in spite of my frequent presence, never allow me to approach without vociferous protest. Hence, by August both look somewhat worn and a bit tired. It is not long before they and their two broods begin to leave my yard—adding their numbers presumably to a great flock of robins which is nightly roosting in a nearby clump of box elders and young cottonwoods. Mr. Robin visits my yard occasionally until about the middle of September, sometimes accompanied by a few of his speckle-breasted young; but somehow he appears restless, and I can guess that the age-old urge of migration has come upon him again. In a few weeks he will be leaving me. Why? Is it because it will soon be too cold for him here? No, for experiments with many of our insect-eating, summer-resident birds have shown that all of them may be kept confined in outdoor aviaries at sub-zero temperatures if supplied with plenty of food. Also, each year, a good many robins seemingly lose their desire to migrate and remain north—even in the latitude of Duluth—all winter. Besides, my robin leaves the yard long before it is really cold, while the insects are still plentiful and before the earthworms have gone deep into their burrows. Apparently, then, migration is not just a matter of either temperature or scarcity of food or of both combined, although both perhaps played a part in far-distant times and doubtless play a part even today.

Perhaps, say one group of theorists, all birds of the Northern Hemisphere were nonmigratory in a distant geological time when conditions of food and temperature were such as to allow them to remain there the year around. But there came a shift in the climate, ice fields formed in the north and, advancing southward, drove the birds before them, thus causing a great concentration of birds in the temperate and tropical latitudes. Then came another shift in temperature, and the icecaps began to retreat, especially in summer, and the inhabitants of the congested regions eagerly repopulated the ice-free parts, retreating, of course, southward, each winter. Therefore, in migrating, our birds are only repeating today the great racial movements that took place in the past, movements associated with the north-south shifts of the ice sheet.

No, says another group of theorists, the ancient home of all birds was in the tropics. Here, due to pressure of population, especially during the breeding season, many birds pushed out from the crowded regions to places where competition for food and nesting sites was less keen. All of these adventurers, of course, retreated southward each autumn before the advancing winter. As the northern ice sheets receded, birds ventured still farther north in the spring but always remembered to retreat to their winter homes at the onset of cold weather.

So, according to these theorizers, a bird of today in migrating may be obeying only an ancient pattern laid down in its nervous system as the result of stimuli now long gone, a pattern perhaps even partly useless today but still functioning—a behavior reaction somewhat comparable to my wearing buttons on my coat sleeves, things for which I can see no use or meaning.

Still others, cashiering most of the above theories, see in bird migration largely a physiological reaction, originating in the sex organs, structures which they say develop periodically as the result of the increased light of the advancing spring. In fact, experiments with birds subjected to artificial light conditions like those of spring, indicated that a condition of the sex organs commonly associated with the spring season developed even in January. But crows so treated and then released were found in equal numbers north and south of the point of release, thus casting considerable doubt upon the validity of the theory. Also, it may well be asked why, if increased length of daylight is the stimulus to migration, do birds that winter in the tropics ever start northward? For there, days and nights are of almost equal length.

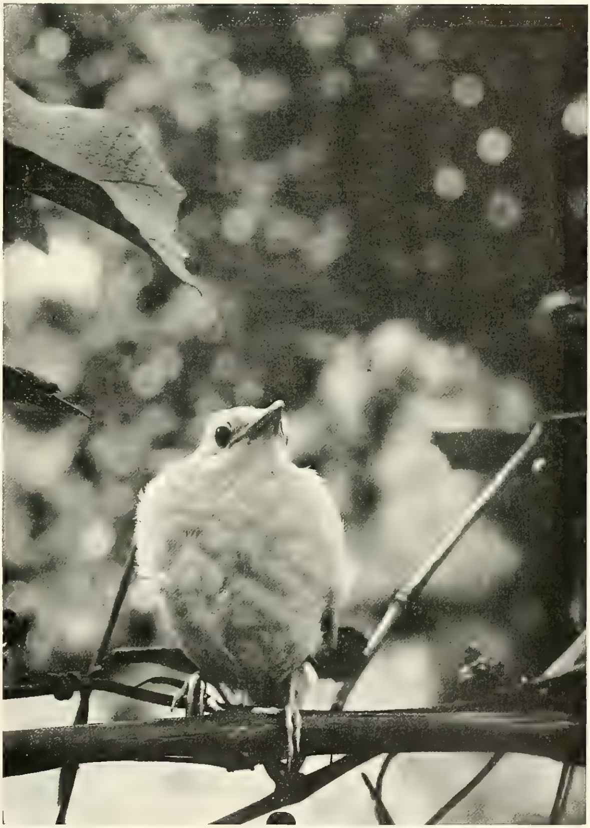
However that may be, I know that by late October my robin will have left me, and will be gypsying along, taking his time, traveling perhaps even more leisurely than when he went north.

My robin is a gypsy

Without him each summer my yard would seem empty. Like thousands of other bird-loving humans, I await anxiously those days each spring when once again a wave of cheery song will ride ahead of the rising sun, starting upon the Atlantic coast and rolling across to me here, even to the Pacific—the morning salute of my robin and his kind.

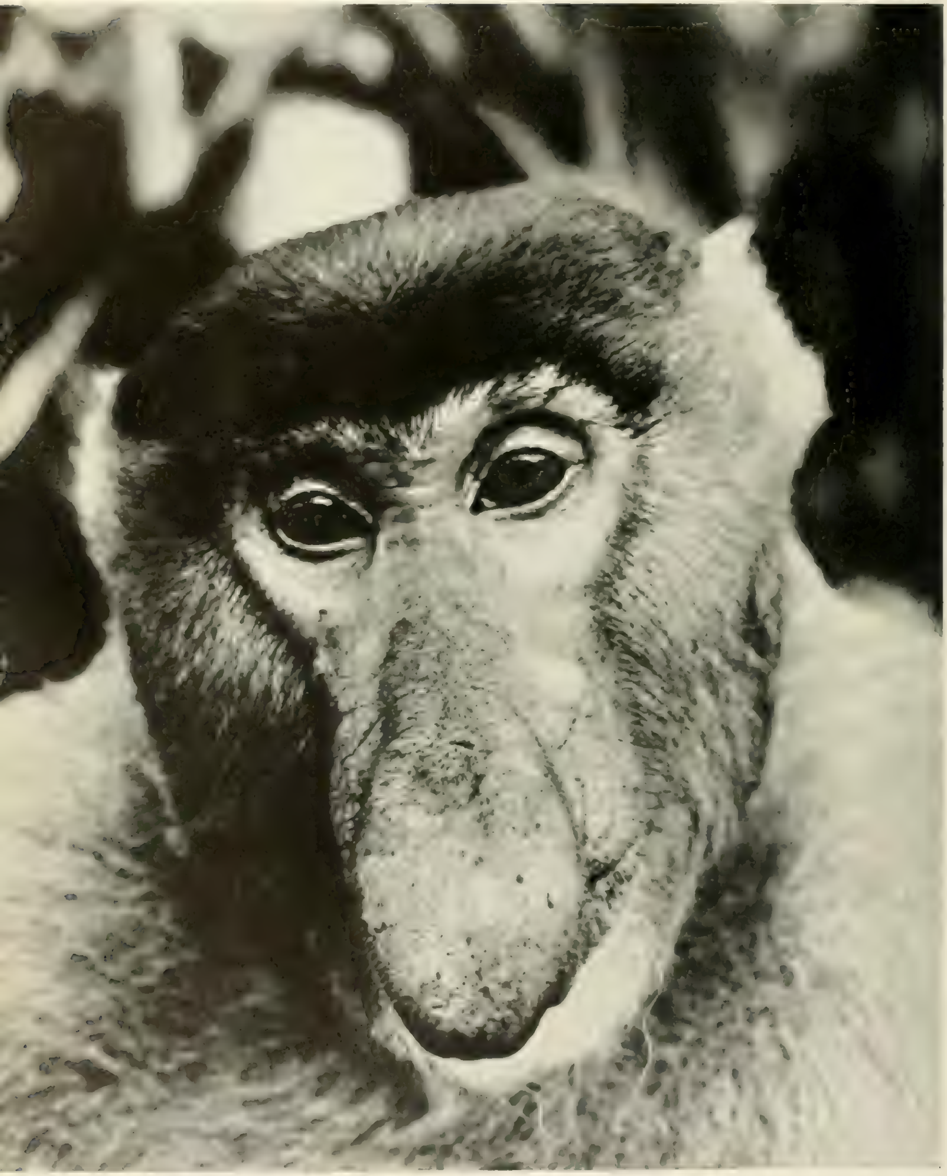
AN ALBINO ROBIN

A photograph by Cornelia Clarke by Courtesy of Henry S. Conard



Seeing Nature

PROBOSCIS MONKEY



rough THE
AMERA'S EYE

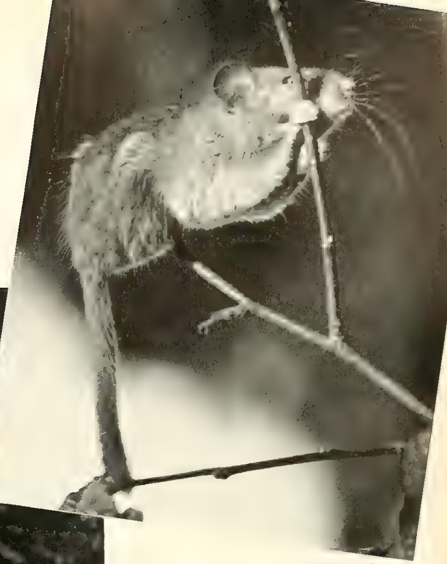
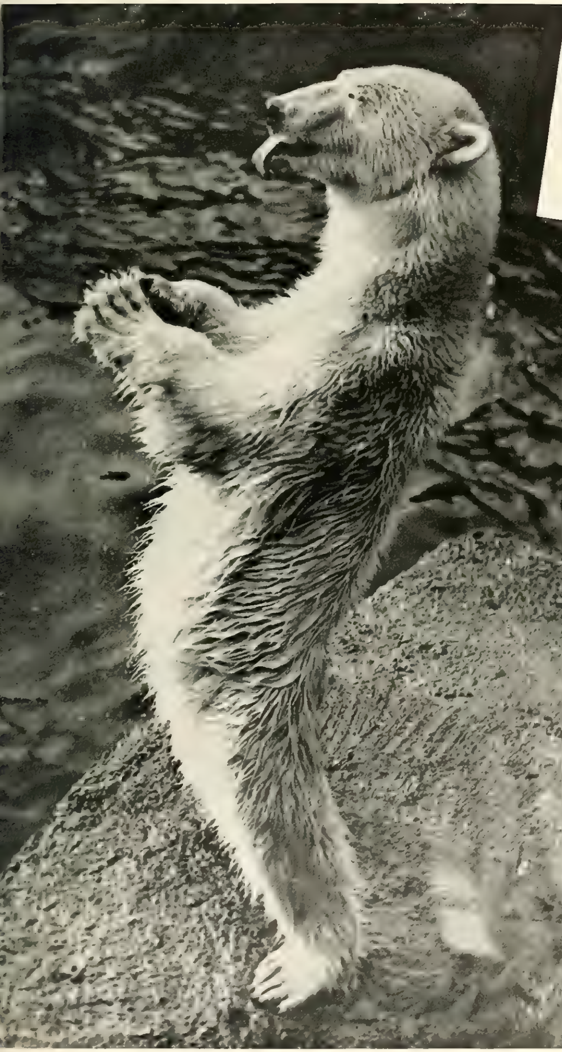


Photo by Fisher

DORMOUSE
at home in his
favorite tree



POLAR BEAR

Photo by Bird

The Evolution of an Evolutionist

Though indifferent to Nature as a boy, he grew up to become her ardent and untiring missionary as well as one of her most penetrating interpreters

By D. R. BARTON

WILLIAM KING GREGORY started [illegible] natural history as a printer's devil, and though he now has the unique distinction of holding two zoological curatorships—Fish and Comparative Anatomy—instead of the usual one, he began his Museum career humbly enough as the first editor of the periodical you are now reading. Typography and journalism were, however, merely two of several "wrong pews" in which he tarried for varying lengths of time before stumbling on his true vocation.

Forty years of uninterrupted Museum service to the contrary notwithstanding, his personal evolution was anything but a straight-line development. It would be pleasant to record that young William's interest in fish dates from the day he first angled with hand-whittled birch pole and bent-pin hook hard by a glistening country rill. But William was a city boy and he didn't care for fishing. Or birds. Or bees. Or flowers. He claims, indeed, that as a child he was singularly incurious about pretty nearly everything. ("At least," he says, "nearly everything I ought to have been curious about.") Yet when we turn the pages of the Senior Year Book of the Class of 1900 at Columbia University, we find that William King Gregory had by that time acquired a habitual curiosity about the meaning of things, which laid him open to this parting thrust by one of his classmates:

> "More hows and whys can William say,
> Than the clock ticks minutes in a day."

What caused such a transformation we cannot, of course, say for sure. But conversions of this sort are supposed to be the result of a slow fermentation within the individual's subconscious, which erupts without warning under proper conditions of temperature and pressure.

At any rate, William began his school days destined for the ministry but lived to create and preach a religion based on the scientific study of Nature. His primary education was entrusted by his mother to the New York Public School System until she read an account in the papers of a public school boy who had been blinded in one eye because a crony unexpectedly snapped a book strap at him. This incident preyed on her mind and shortly thereafter, when a furrier's son snapped a fox tail at young William's eye, she promptly transferred her boy to Trinity School.

WILLIAM KING GREGORY

William suffered from the incident neither physical disability nor mental perturbation, and it failed to rouse in this comparative anatomist of the future any curiosity whatsoever as to the internal structure of foxes or of the human eye. But it left him with the subconscious basis for subsequent belief in that theory of history which holds that the fate of individuals or of nations is determined by a series of accidents. However that may be, it seems clear that the accident of the snapped fox tail determined in part his subjection to the environment of Trinity School where he first struggled with Latin grammar to the tune of horse-cars rumbling in the street outside.

Another accident

Before entering the printing business, Gregory Senior had made a living at tuning church organs and he joined his good wife in the hope that their son would take the episcopal orders. William had no reason not to acquiesce in their choice of calling. He was compliant by nature, he loved his parents, and, as it later turned out, possessed a certain latent capacity for evangelism. But with the passage of time he attained a profound interest in his family history, which caused him to look up a number of relatives whose inclusion within the bosom of the family would certainly have startled his immediate progenitors. It was his discovery of these relatives that caused him in later life to pen the following remarkably candid self-portrait:

"I undoubtedly inherit the general ground-plan of my face," he writes[1], "from my excessively remote shark-like ancestors who possessed paired olfactory capsules, paired eyes and paired internal ears, arranged in the order named, and who had a medium mouth below the nose and eyes. I also owe to these humble creatures the framework of my tongue and vocal organs, my jaw and throat muscles and many other features both useful and necessary.

"Next, I owe to the primitive lobe-finned fishes or crossopts the complete bony scaffolding of my face and jaws, which in them lay on the surface but in my own face is deeply buried beneath the flesh.

"Then I owe to the higher mammal-like reptiles the fact that the right and left halves of my lower jaw are composed of a single piece and that I have a set of teeth limited to the margins of the jaws and differentiated into incisors, canines, pre-molars and molars. I also owe to these hitherto much neglected animals the 'basic patents' for the delicate apparatus of my middle ear, together with my bony palate and several other important parts of my make-up.

---

[1] [illegible] Man, Putnam, [illegible], p. 225.

"In the earliest mammals the bony mask became covered with mobile, sensitive flesh; to them I owe also the very hairs of my head, my eyebrows, eyelashes and other facial accessories.

"To my earliest primate ancestors I owe the large size of my eyes and a considerable part of my brains.

"To my friendly anthropoid ancestors I am heavily indebted: for eyes that can focus on things near at hand, that give stereoscopic pictures and that follow closely the flight of a moving object; for a nose that is a real nose and not a snout; for lips that can smile and laugh or curl up in anger or kiss in love; from them I inherited all my baby teeth and my thirty-two adult teeth; the very shape of my ears is theirs. . . . On the deficit side also there [is a] slightly warped septal cartilage of the nose, together with slight maloccusion of certain teeth and a failure of two wisdom teeth to erupt. Thus I can explain my face although I cannot improve it."

Fair enough. But it was for no such heady reasons as these that he digressed from the clerical path which his parents had mapped out for him. An "accident" intervened in the shape of a young lady. Her brother, William's closest friend at Trinity, aspired to become an electrical engineer. And William, sizing up the situation, saw no good reason why he should not suddenly develop a burst of enthusiasm for the same profession. The friend, naturally enough, was delighted with this new intellectual kinship and frequently invited William to his home.

However, it must not be imagined that this was a case of calculation in cold blood. William revised his entire curriculum and set about his unfamiliar tasks in good faith, plunging up to his neck in the practical sciences. Nor did he begrudge the tedium of nocturnal study or the odors of the chemistry lab. For was it not a labor of love?

But, despite the fact that his aptitude and perseverance won him a scholarship at Columbia, his interest in electrical engineering waned—(we have no way of knowing how much the "accident" had to do with this)—, and at the close of his sophomore year he laid his troubles before the dean. The latter encouraged him to make the difficult decision of abandoning engineering lock, stock, and barrel even though this meant the loss of all academic credits for two full years of work.

Still quite at sea intellectually, young William started all over again as a freshman in the old School of Arts, Columbia College. But when all seemed darkest came the glimmerings of a new day. A host of minor accidents apparently conspired to bring Gregory under the literary influence of a renowned philosopher and later under the personal spell of two great scientists. The literary influence came by way of Drummond's *The Natural Law in the Spiritual World,* a work which sought to resolve certain differences of viewpoint between religion and science. Some of these differences had already come to strife in Gregory's own mind, and *The Natural Law in the Spiritual World* had an effect upon him which was quite different from its author's intent. For it inflamed him with the idea of studying biology, a branch of science of whose existence he had previously been scarcely aware.

The masters

About this time, Henry Fairfield Osborn had vacated a chair in Comparative Anatomy at Princeton University to accept a Columbia professorship and, in addition, the task of creating a Department of Paleontology in the American Museum of Natural History. There already existed considerable co-operation between these two halls of learning, but with Osborn's arrival the bonds were greatly strengthened. Under Gregory this tradition of scholarly liaison work was later even further extended. But more of that anon.

Another zoologist of this epoch also held positions of importance both at Columbia and at the Museum. This was Bashford Dean, a man of astonishing versatility, whose scholarly attainments were expressed through a seemingly dual nature. Founder of the Department of Ichthyology and a zoologist of world repute, he nevertheless found time to establish himself as an equally eminent student of art. His lifelong interest in armor resulted in a collection which can be seen today on the other side of Central Park at the Metropolitan Museum, and he is probably the only curator in the history of either institution whose name will remain imperishable in both.

As for Osborn, the growth of the American Museum under his presidency is too well known to require mention here. But at the time Gregory switched to biology at Columbia, Osborn was still a young paleontologist for whom, as Gregory eventually wrote[2], "dry bones came to life and giant forms of past ages joined the pageant of the living."

Dean and Osborn were themselves giants, each in his own way, and it was under their care and nurturing guidance, first at Columbia and later at the Museum, that young Gregory grew intellectually to the point where both could bequeath to him the heritage of their professorships with the secure knowledge that the double burden would fall upon able shoulders.

One September morning in the late 1890's, Gregory wandered into Bashford Dean's lecture room for the opening class of the year. "A few minutes after Dean mounted the rostrum to lecture on the armored fishes of the Devonian age, I was caught," Gregory says. "In fact, I swallowed the whole thing hook, line, and sinker." No truer words could be spoken. His interest in fish has never wavered.

In due time Gregory became Dean's pride and joy. The latter encouraged his young disciple and even managed the establishment of a traveling fellowship in zoology in order to take him on a maiden collecting trip to California. His patient instruction bore fruit, and after graduation Gregory was appointed his assistant.

Meanwhile Osborn, whom Gregory still reverently calls "the Professor," had commenced to weave his spell. But it was not until he brought his young pupil to the Museum as librarian for his collection of paleontological papers that things began to happen.

Previously Gregory, under Bashford Dean's direction, had assisted the latter in rearranging and classifying the library of the New York Academy of Sciences and he was well equipped to undertake the Museum job which, incidentally, included the editing of the *Journal of the American Museum of Natural History*[3]. His work with Dean—whose study of the armored fishes jibed conveniently with his avocational inquiry into the development of human armor—had broadened his conception of the evolutionary principle. Yet, up to this time he had merely an academic interest in mammalian paleontology. Dissecting fishes and charting the developmental changes of a given internal organ were fascina-

---

[2] Doctor Gregory is the official biographer of both Dean and Osborn.

[3] Later renamed NATURAL HISTORY Magazine.

[illegible] But [illegible] will [illegible] At that [illegible] when the Profes- [illegible] the [illegible] skull [illegible] [illegible] of the creature's erstwhile habits. The broad outline of this dusty science provided a useful background for the [illegible] was content to leave the particulars to others. Then presently he began investigating a few bones on his own, and a year or so later he published a bulletin on the "Adaptive Significance of the Shortening of the Elephant's Skull."

He had snapped at Osborn's bait and soon was serving his two masters both at the Museum and at the University, where he later became Professor of Vertebrate Paleontology. Gregory feels greatly indebted also to the late Museum Curator of Paleontology, Dr. W. D. Matthew, who furthered his scientific development by means of many stimulating discussions. In 1906, Gregory was elected to the New York Academy of Sciences and, feeling his zoological oats, so to speak, flung himself on the abstruse and ticklish problem of the genetic interrelationships of the swarming families of the higher fishes. This was published by the Academy in 1907 and has been the foundation for all his subsequent studies on fossil and recent fishes. The next venture was his volume on *The Orders of Mammals* (1910), a work for specialists which he feels to be his magnum opus. "If anything I have written is going to be read 100 years from now," he says, "it will be that book."

However, some independent observers might take exception to this selection and rate Doctor Gregory's work on the history of dentition from the first appearance of teeth in the animal kingdom to the present, as of fully comparable importance.

Professorial curator

Weighty researches of this nature left him little time for field work. Next to Mr. Whitlock[4], Doctor Gregory ranks as the Museum's most sedentary curator and is far from being a ruddy, two-fisted explorer. Yet, even though the complexion of his entire career bears upon it the pale cast of thought, journeys to far-off places have by no means been excluded from his scheme of things.

Soon after he developed his belated passion for paleontology he made several field trips in the far west and, following World War I, he was dispatched in the company of his close friend and colleague Harry Raven to collect a representative series of Australian mammals, together with accessories for a proposed exhibition hall devoted to that continent. Then in 1925 he was invited by the New York Zoological Society to accompany William Beebe on the famous cruise of the *Arcturus* to the Sargasso Sea. This trip eventually resulted in the Hall of Deep Sea Fishes which stands today as one of the most impressive and unusual exhibits in the Museum.

In 1929 he took part in a joint expedition to Central Africa dispatched by Columbia University and the American Museum to secure and preserve the bodies of adult gorillas for comparative anatomical study.[5]

During the years when he was acting as assistant to Professor Osborn, Gregory was instrumental in planning exhibits in the halls of the Age of Man and of the Age of Mammals, each of which was made possible by researches conducted jointly by Osborn and himself. Recently, Doctor Gregory made a voyage to South Africa for the purpose of studying the fossil specimens of extinct man-apes described by Dr. Robert Broom. And two years ago he made a penetrating investigation of the shell forms which he collected on the beaches of New Zealand[6].

Thus it seems that for a boy who was so extraordinarily deficient in ontological curiosity, Doctor Gregory has done rather well in later years. His insatiable greed for understanding the reasons for things as they are, has led him into many lines of Museum activity and he holds titles, honorary or official, in the Departments of Fish, Comparative Anatomy, Paleontology, and Anthropology, as well as honorary degrees and memberships abroad. Actually he is listed on the Staff as Curator of Ichthyology and of the Department of Comparative Anatomy—the latter having split off from the larger specialty of Paleontology in 1921, when the need for laboratory research as distinct from field collecting became apparent.

A few years later, Bashford Dean found his health obliging him to withdraw more and more from his Museum work and he requested President Osborn to allow his erstwhile disciple formally to take over his department. The Professor acceded, and Gregory became the first dual curator in the institution's history.

In spite of his wandering in other fields, he remains true to his first love—fish—, partly because for him the phrase "from fish to man" implies a continuous study all along the evolutionary line and at both ends. His paramount ambition is to build bigger and better exhibits in the halls devoted to evolution. But he complains that, after he and his colleagues have perfected plans for installing exhibits to illustrate the most spectacular results of their research, there is often neither space nor funds available for construction.

He was therefore naturally elated when a few years ago Michael Lerner, the famous game fisherman, saw an opportunity to combine science and sport and accordingly launched a series of expeditions to many parts of the world which are yielding a steadily increasing harvest. One of the evidences of this activity is seen in the newly installed exhibit "Game Fishes of New Zealand" and in a growing array of scientific reports on this and related material.

Though handicapped by a slim budget, the Fish Hall abounds in exhibits of dramatic beauty and educational clarity, although some might feel that Doctor Gregory's gratitude to the sharks for their contributions to his face has prompted him to display these creatures in a profusion suggesting ancestor worship of the most idolatrous sort.

When it comes to comparative anatomy, "No one," he laments, "seems to get very enthusiastic about a thing like the history of the dentition. You couldn't name a more important phase of evolution but it simply has no romantic appeal." Nevertheless, dentists and other students of teeth all over the world are using the books and papers on this subject written by Doctor Gregory and his collaborator, Dr. Milo Hellman.

If Doctor Gregory's Department is short of cash it is certainly long on brains. By extending the co-operation between the Museum and Columbia, initiated under Osborn's regime, he has given the former institution the benefit of an imposing bulk of research work, done free of charge in exchange for the use of scientific collections. The workers, in this case, are his students who have been drawn to him from all over the world and who know and love him not only as a teacher but for his unsparing devotion to science and for the fact that he leaves no stone unturned in his unusually successful efforts to place all of them in congenial positions on the faculties of leading colleges and universities throughout this country and abroad. Indeed, as a teacher he has influenced many Museum careers, several members of the Staff being graduates of Doctor Gregory's course in the development of the vertebrates.

---

[4] [illegible]

[5] [illegible] William K. Gregory [illegible]

[6] [illegible]

Out of this widely distributed bumper crop, Doctor Gregory hopes to see a new generation of inspired teachers arise to enlarge and disseminate knowledge of the history of life on earth. In great teachers and in the inquisitive students of future times, he places his faith, for he well knows the value of this happy combination in his own life.

Thus the boy who was indifferent to natural history lived to smite his lyre in her behalf:

> "Oh let us give praise unto Natural History: for she hath revealed the splendor of the heavens.
>
> . . . .
>
> "The chronicles of the ages are here; the generations of living things are numbered in her book; the records of their origins are graven upon her tablets . . ."

And the boy who foresook ecclesiastical orders for those of mammals and other creatures living and dead, grew up to preach the gospel of science:

> "If an evolutionist ever felt impelled to make a prayer, he might well pray somewhat as follows:
>
> "Behold, O Lord, man vaunteth himself foolishly and is puffed up in vain; seeing that he is but a scion of the apes and a descendant of them that dwell in the branches.
>
> "Yet hast Thou taken pity upon him; Thou hast raised him up on his feet and exalted him above his fellows.
>
> "But his pride hath been his undoing; his wickedness is the cause of his downfall.
>
> "The Magicians pipe and the multitudes dance; false prophets arise and lead the people into foolishness.
>
> "Save us, O Lord, from their machinations; help us to resist their power with stout hearts and to confute their magic with our understanding of its vanity.
>
> "And they that deceive the people with witchcraft shall be driven forth out of their holes; and our young men shall slay the giant Superstition with the pebble of Science.
>
> "Above all send us teachers, O Lord, who shall teach wisdom to the young and understanding even to the babes and sucklings.
>
> "So shall our youths and maidens behold the everlasting power of Thy works, and the infinitude of Thy creation.
>
> "And they shall proclaim a new vision of holiness and a message of salvation to man."

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INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

[illegible]

1. [illegible] ring?

2. [illegible]

3. Pumice is:
   (a) Petrified sponge
   (b) A coral formation
   (c) Solidified lava froth

4. Is it possible to mistake a diamond for both a ruby and sapphire at the same time?

5. Diamonds can withstand the blows of a blacksmith's hammer.
   True .... False ....

6. The largest man-made structure ever conceived is:
   (a) Empire State Building
   (b) [illegible]
   (c) Grand Coulee Dam

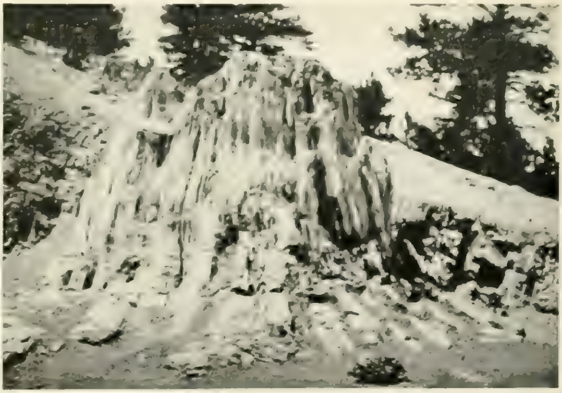
7. Its temple is as tall as the Cathedral of Notre Dame, its people created one of the great civilizations, its ruins are hidden in the jungle, and modern armies threaten to fight over its territory. What is it?

8. A box full of sand will weigh more than the same box full of marbles.
   True........ False........

9. Name the only gem stone that is composed of a single element.

10. What is the object illustrated below?

ANIMAL, VEGETABLE, OR MINERAL? A distinctive photograph of one of nature's wonders, submitted by Pearl M. Maus (Answer on page 244)



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Controlling Color in Kodachrome

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

PHOTOGRAPHY in color has become so popular these days that the scientist, amateur and professional, is using it more and more to make records of natural science phenomena. The addition of color to photographic records has made them ever so much more attractive as well as useful. Marvels of chromatic brilliance grace the screen of many a lecture, and we are beginning to regard a lecture as dull if it does not have slides or films in Kodachrome.

Along with the widespread use of color film has come a finer appreciation of good color rendition and pictorial composition. No longer does mere color evoke the awe it formerly did. Anybody can make color pictures today, and only excellent color and good composition attract attention now.

Faults of color photography

One of the first lessons learned about Kodachrome is that it has no subjective reactions. What it sees is not colored by previous knowledge or experience. When the color film sees grass, it doesn't insist, as we are so apt to, that all grass is green. It may see brown grass or blue grass or other colors that look all wrong to us in the processed film.

You have probably observed the cold, gray dawn of a winter's day. If you look at a snowbank through a window of an electrically lighted room, you will see that the light outside appears to be a deep blue. As soon as you step out into the open, however, the blue disappears and the world looks gray and drab. A Kodachrome taken before sunrise will exhibit a brilliant blue tone, proof that blue was the actual color of the light on the snow.

On a cloudy day during which no sunshine can be seen, blue light predominates. Kodachromes made on a cloudy day show a bluish cast that throws most colors too much toward the cold tones. Pictures of leaves, lichens, insects, animals, or any other outdoor subject taken on a cloudy day are far from truthful records of what we saw.

Correcting Kodachrome's vision

Although many photographers don't like to bother with filters, their objections ought to be quickly overcome by the tremendous improvement in color rendition. When you have made a special trip to get some color pictures of a specimen and the day suddenly turns cloudy, you will thank your lucky stars that you have filters to offset the changed light quality.

The first filter that you need to make Kodachrome see things your way is a Wratten 2A. This is a very faint yellow filter, but its effect upon Kodachrome is much more drastic than the delicacy of its tint would indicate. The secret of its power lies in its treatment of the ultraviolet light which, although invisible to the eye, affects the Kodachrome film strongly. This filter is the one to use for all subjects taken either on a cloudy day or in the shade on a clear day. The 2A filter eliminates the ultraviolet light and with it the bluish appearance of a subject which, while actually present, we completely ignore visually. Our brain tells our eyes that there is no bluish cast. We must tell the Kodachrome the same thing by using a filter. No increase of exposure is necessary.

The 2A filter is also useful in overcoming the blueness of the light from flash bulbs when used indoors with Kodachrome *A* or *B*.

The polarizing filter

We see and photograph all objects by means of light reflected from them. This reflected light consists of two parts: the surface reflection which retains the color of the light source, and the remnant of the light which has penetrated the surface of the object and has become colored by it.

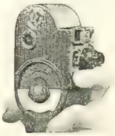
Look at a glossy leaf carefully. Part of its color is due to the blue of the sky which it reflects, while part is due to the green color of the leaf itself. If you were to make a color picture of this leaf, the finished film would show a leaf bluer than it actually was because of the sky reflection. This surface reflected light dilutes the color of many objects, even rough-surfaced specimens, so that it is very difficult to obtain true color.

When a photographer is bothered with reflections on the glass of a store window, he pulls out his polarizing filter, slips it over the lens, rotates the filter until the reflection disappears, and then makes his picture.

Borrowing this trick, we can put a colorless polarizing filter over the Kodachrome camera lens, turn it until the sky reflections disappear from our leaf surfaces and then make our picture. Thus, pictures of trees look far better because of the improved rendering of the green leaf color. An amazing revelation will come when photographing a cornfield. The corn leaves change from bright blue to dark green as the polarizing screen is rotated before your eye. Clip it to your lens in its most effective position to reproduce the true leaf color.

Because the polarizing filter throws away the light from the undesirable reflections, an increase of exposure is required —about double the normal—to compensate for this loss.

We photographers are now beginning to learn how to see color and can critically view our efforts at recording it, and the inaccuracies of our vision are becoming apparent. So when we do not get perfect color photographs, it is well for us to ask whether the reason is not perhaps in ourselves rather than in the film.



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ZOOLOGY ● OUR TREMBLING EARTH ● FAMOUS SCIENTISTS

INDIAN ART OF THE UNITED STATES

by Frederic H. Douglas
and René d'Harnoncourt

The Museum of Modern Art, New York, $3.50

INDIAN ART OF THE UNITED STATES [illegible] M. H[illegible] In-dian Art at the Denver Art Museum, and Mr. d'Harnoncourt who has long been interested in contemporary Indian affairs in Mexico and the United States, is now General Manager of the Indian Arts and Crafts Board of the U. S. Department of the Interior. Therefore, both are peculiarly fitted to make this vital and constructive presentation of Indian Art in the past and present. Whether or not the reader has [illegible] text and its lavish accompaniment of well selected illustrations, a most impressive book on art and life among our Indians.

The authors open their book with an Introduction covering tribal traditions and progress, general comments on Indian art, [illegible] voted to the prehistoric art of the carvers of the Far West and the Northwest coast, the engravers of the Arctic and the sculptors of the East, closing with the painters of the Southwest. They make their divisions in terms of the type of art rather than according to archaeological nomenclature.

A chapter on pictographs comes next; then a long section on the living artistic traditions of modern tribes, which are described in terms of the manner of life of the makers, since tribal names do not have so clear a meaning for the casual reader. The last part of the book is devoted to Indian art adapted to modern living, accompanied by an adequate bibliography arranged for nontechnical interests.

The splendid text, rich illustration, and low price make this a book for ownership, not library consultation. Our growing interest in things American will find satisfaction in this splendid volume by two authors who illumine their great knowl-[illegible] standing of Indian life.

George C. Vaillant

STUDIES IN AMERICAN DEMOGRAPHY

by Walter F. Willcox

[illegible] N. Y.

"PROGRESS," declares Professor Willcox, "is movement or change toward a limit." For the demographer it is the changes, adaptations, and integrations of a population in statistical terms. In this sense, then, the progress of the United States [illegible] From among his varied population papers, Professor Willcox has selected twenty-odd studies which deal with various tests of our national progress. For example, the increase in length of life, the growth of population, birth and death rates, classifications by residence age, sex and marital condition, literacy and various other criteria are examined minutely and critically for trends in national development.

Professor Willcox is one of the leading demographers in this country and out of the rich harvest of a fruitful professional life he presents this omnibus volume. It is full of pregnant observation and stimulating suggestion, and although written in the first instance mainly for professional readers it contains much of value for others as well.

H. L. Shapiro

OUR TREMBLING EARTH

by Joseph Lynch, S.J.

Dodd, Mead, $3.00

A POPULAR discussion of earthquakes and seismology seems to be a very difficult task, but we could ask no greater authority in this field than Father Lynch. It is fortunate that we should have a readable work on the subject by so eminent a scientist. Too many popularizations of science are written by authors with naught but a facile pen.

The book tells what earthquakes are and what causes them. It describes the instruments which record them, with special reference to Father Lynch's own observatory at Fordham, discusses the distribution of seismographs over the world and tells about the organizations which assemble the data on each earthquake. Earthquakes at varying distances and the different kinds of waves recorded for those distances are shown, an explanation is given of the means by which the observer can tell from a complete record the approximate direction and the exact distance of the slip from the station. And all of this is done without the complicated formulae which usually scare off the non-[illegible]ded reader before he [illegible]

The work is excellent and authoritative but, in common with most scientists, Father Lynch finds it difficult to write for the popular public. So many explanations are needed; but he does not seem always to have chosen the most propitious time for his detours. With hundreds of Jamaicans lying dead on the ground, we discuss the height of a top hat, and as Japanese villages topple like cards, we hear about tides and tsunamis. In "The Value of Seismology to Geology" we read principally about Father Lynch's ingenious new theory of the state of the core of the earth, but find no suggestion of the many zones lying between it and the crust.

T. H. [illegible]

BEHIND GOD'S BACK

by Negley Farson

Harcourt Brace, $3.50

ONE of the great prizes of the present war is Africa. God may seem to have turned His back on it, for a large part is unsuited to permanent white settlement, but it offers a vast field of exploitation. In the last year before war, Negley Farson traveled over wide stretches of South Africa, and then with his courageous wife crossed from East Africa to the Belgian Congo and the Cameroons. Finally, on the Gold Coast, he fell in with an earthquake. Two months later the upheaval in Europe commenced.

The whole tour occupied only seven months, but Farson is uncommonly quick at recording real political conditions. What he found in some areas was hair-raising. For the African native he has intense sympathy, a feeling notably lacking in white men who go to Africa to feather their own nest.

In colonies with bad climate and dense black population the native is apt to be well treated. When labor is scarce he may be exploited financially yet otherwise protected. Where white settlement is easy, the native is usually oppressed. Nationalistic rivalry among whites causes severe tension, and Indian immigration has added another immense difficulty. Territories under mandate of the League of Nations were conscientiously administered. On the whole, concludes Farson, English rule in Africa gives the native the best chance of progress, despite inefficiency in economic planning.

The book leaves much to be desired

when fauna and flora are described. Its author is a sportsman, and hunted lion and buffalo, sparing most other game except waterfowl. But Muscovy ducks do not occur wild in Africa, marabous are not cranes, and his toucans should be hornbills. Mahogany and ironwood are not the main constituents of the Congo forest, and tapioca is only a finished product from the manioc root.

To call attention to such errors is almost unfair. We have here a most exciting report on conditions of tremendous import to a widespread and cantankerous mammalian species—man himself.

James P. Chapin.

THIS IS OUR LAND

- - - - - - - by E. G. Cheyney and
T. Schantz-Hansen

Webb, $3.00

THE authors have written a book designed to teach the young people of this country the significance and vital workings of their heritage in this continent. First is described the promise and wealth of the land before the unbalance caused by our civilization. Then follows a description of the spectacular abuse caused by the heedless ignorance of the people who developed the land and resources. After the description of each misuse, the writers tell what is being done to remedy the condition and suggest what further can be done.

The book is generously illustrated with well-chosen pictures that demonstrate each point. At the end of each chapter are 20 review questions, a group of about ten suggestions for correlated activity on the student's part, and a subject for debate on the contents of the chapter.

The text is written to make the material interesting and challenging to the student. The questions and suggestions are of great assistance to the teacher. It is a book that should be studied in all schools that are interested in their pupils as citizens—not as mere receptacles of unrelated facts.

John N. Carley.

MAN'S FIRST MILLION YEARS

- - - - - - - - by Jannette M. Lucas

Harcourt, Brace, $2.00

MISS LUCAS, who for many years has been associated with the American Museum, has here attempted a simple, easily-understood account of the history of man's physical evolution and of his early cultures. It is a short book, written in a frankly popular vein, and is obviously intended for the layman or as a young student's introduction to this most fascinating and significant field.

The book contains a brief account of mammalian evolution as it led toward man, and in the order of their actual appearance, discussions of each of the most important fossil men,—Java Man, Peking Man, the Neanderthals, etc. Coupled with this are descriptions of each of the major stages in the progress of man's cultural development throughout the Stone Age. This method of presentation is an admirable feature of the book, skeletal remains being considered wherever possible in conjunction with their respective cultures and thus clearly indicating the related progress of both. Included are a chart showing the correlation of men and their cultures with glacial movements, and a fair number of drawings of artifacts and of reconstructions of early types of man.

The book suffers somewhat from inaccurate phraseology which in several instances, I think, might confuse the beginner. Also, perhaps, there is some unwarranted speculation in regard to such things as the mental processes of early man, more permissible in a popularization of this kind than in a scientific work, but giving the impression of being a bit too "popular" at the expense of accuracy. Remembering, however, that the subject dealt with is extremely complex and difficult to state in simple terms, it is clear that this book is a definite contribution to the popular literature on the subject.

G. F. Ekholm.

PEACOCKS AND OTHER MYSTERIES

- - - - - - - by Jean de Bosschère,
translated from the French by
Frederick S. Hoppin

The Brick Row Book Shop, New York, $2.50

ALL life is mysterious, and to one who loves birds in the mystical fashion of Jean de Bosschère, peacocks are particularly puzzling. The first half of this little book discusses the ways and the gorgeous plumage of peacocks which he kept on an estate in the Land of the Blue Thrush, as he calls the Roman Campagna. Its second half is a collection of nine essays in which we learn to know the author intimately, for he tells us of his early love of birds, his remorse in boyhood at causing the destruction of a lark's eggs, his acquaintance with bird fanciers, and his own passion for living birds. Yet the deep sorrow at having harmed a bird continues throughout his manhood.

This is literature in the best French manner, rather than ornithology, and the author is exceedingly sensitive. Though deeply shocked by his neighbors' treatment of birds, whether domestic or caged, he cannot help loving these human tyrants as much as he does their victims. His greatest admiration, naturally, goes to kindly men who, like Saint Francis of Assisi and the poet Miloz, could attract birds without doing them harm.

The peacock never departs from a formal almost conventional gravity, observes de Bosschère, and appears to suffer from nostalgia, if indeed he is not a confirmed hypochondriac. He has the wings of an angel and the voice of a devil. His delicate chicks give notes that suggest a broken-hearted flute, and they look, we are told, very like diminutive ostriches.

Other topics briefly discussed are the reactions of chickens to their first snowfall; the behavior of a guinea chick hatched with a brood of ducklings under a hen—it actually followed them into the water just once; the "bootlegging" of native cage-birds in Paris; and pigeon racing for sport in Belgium. Interest in birds expresses itself in many and devious ways, and here is a book that proves it.

James P. Chapin.

FAMOUS MEN OF SCIENCE

- - - - - - - - - by Sarah K. Bolton

Crowell, $2.00

THIS is the eighteenth printing of a book which was first issued in 1889. The present edition has been enlarged by the addition of a chapter on Luther Burbank. It is a work composed of short biographies of Copernicus, Galileo, Newton, Linnaeus, Herschel, Cuvier, von Humboldt, Davy, Audubon, Faraday, Lyell, Agassiz, Darwin, Pasteur, Fabre, Kelvin, Edison, the Curies, Marconi and Burbank.

Such subjects make for dramatic reading and the author has done full justice to her subject. The inclusion of so many studies in one book requires a great amount of condensation. At times the subjects neglected were of much greater importance than those included. As a specific example, no mention is made of the publishing of the tenth edition of Linnaeus' *Systema Natura*, the basis for all modern taxonomic studies, and the work itself receives mention only once—and then only of the difficulties in publishing it. There are some completely inaccurate statements, though these are generally of minor importance. Paleontologists, for example, will be surprised to learn (p. 253) that *Archaeopteryx* was found in England. And it is difficult to understand (p. 5) how Aristotle "had contrived" to get his "strong beliefs backed by the Roman church."

Henry W. Longfellow wrote:

"Lives of great men all remind us
We can make our lives sublime,
And departing, leave behind us
Footprints on the sands of time."

Mrs. Bolton seems to have been fully conversant with this thought. This book was first published in 1889, and in many places has a truly Victorian style, which is generally pleasant, but at times the author strives too hard to point the moral.

All these criticisms are of essentially minor importance, and the book itself remains pleasant and profitable reading.

H. E. Vokes.

JOHN KIERAN'S NATURE NOTES

Doubleday, Doran, $2.00

THOSE who listen to "Information, Please" and those who read the sports columns of *The New York Times* will be interested to learn that John Kieran has put into book form some of his observations of the fields and woods—dragged out of him, as he says, by Colonel Theodore Roosevelt. Thirty-six very short essays—we wish they were longer, about "common trees, common birds, common animals, and common flowers" make up the little volume.

[illegible] taught me have left me humble, hopeful [illegible]

[illegible] of nature, he has included how the witch [illegible] pigeon drinks, how the turnstones got their name, how a polar bear swims, and the dramatic story of the Sea Gull Monument in Salt Lake City—how Franklin's gulls saved the lives of the Mormon pioneers. He writes of our smallest bird, the hummingbird; of our largest animals, the whales; of our largest trees, the sequoias; and of many creatures of average size. The reader will be amused by the decisive way in which he disposes of the popular belief that rattlesnakes, prairie dogs, and burrowing owls live together in harmony.

One may doubt the theory he accepts of why long-billed marsh wrens build extra nests. But all will find this little book a welcome relief from the turmoil of a [illegible] world.

[illegible]

A TEXTBOOK OF ZOOLOGY, VOL. II (VERTEBRATES)

by T. Jeffery Parker and William A. Haswell

Revised by C. Forster-Cooper

Macmillan, $9.00

AMONG a throng of zoological text books Parker and Haswell is unique, and only British conservatism can explain the use of its old and unpretentious title for this essentially new manual of animal anatomy and relationships. The true lover of natural history, no less than the earnest student, eventually reaches a point where he is no longer satisfied with elementary and superficial books but wants clear, authoritative information about a thousand details of animal structure and history. Then he will turn with confidence and pleasure to this book, whether he wishes to study it systematically or to use it as a reference work to clear up specific points. It is technical in that it employs exact scientific terms rather than popular approximations of them, but its explanations are lucid and are accompanied by a wealth of clear illustrations.

The format and much of the text are entirely new, but well-tried features of the old "Parker and Haswell" are retained and brought up to date. Representative animals, chosen as far as possible so as to be available for firsthand observation by the reader, are described in detail, with adequate summaries of the peculiarities and variations of their relatives. Notes on classification, relationships, distributon, and habits are shorter but adequate for general purposes.

An outstanding feature of the revision is the inclusion of excellent brief discussions and many illustrations of fossil vertebrates, so that the animals of today are seen in true historical perspective. The [illegible] detail quickly available and greatly increases the usefulness of the book.

This volume is of basic importance for any working library of natural history, whether amateur or professional.

G. G. Simpson

CANNIBALS AND ORCHIDS

by Leona Miller

Sheridan House, [illegible]

IN New Guinea there are still blank spots on the map where no white man has been and where natives carry on their daily lives by Stone Age methods, ignorant of or ignoring the white man's civilization and his government. Such is the unusual setting for Mrs. Miller's story of adventure, which has for its framework the trip into the interior of Netherland South New Guinea that her husband Mr. "Cannibal" Miller, described in *Cannibal Caravan* two years ago. But this is the primitive as seen through a woman's eyes, and a woman's reaction to it. The matter-of-fact recording of the fear experienced on seeing a huge reptile; her husband inheriting a chieftainship by killing the chief and then participating in a head-hunting, cannibalistic raid; witch doctoring, birth, drunken orgies, free love, sudden death and the offer of a native to buy the authoress from her husband are breath-taking or amusing, depending on your point of view. The tale never lags, is cleverly written, and makes good reading.

Local color is carelessly put in: there are impossible ptarmigan, toucans, humming birds, and vampire bats; the "Tertiary period, with its dinosaurs, giant turtles and scaly monsters" is said to persist; the descriptions of the country and customs are vague and unconvincing.

A. L. Rand

LIONS ON TRUST

by Cleland Scott

The Macmillan Company, $3.00

ONE would hardly consider lions as ideal household pets, but Mr. and Mrs. Cleland Scott, who own a ranch near Nanyuki in Kenya Colony, British East Africa, find them most interesting, if not ideal. The Scotts have had about a dozen lion cubs in their home at one time or another, the most entertaining being Romeo and Juliet. These last were purchased as small cubs from the zoo in Nairobi. At the time of the writing the cubs were over two years old and weighed about 300 pounds each. As one can easily imagine, such animals in a home were not too considerate of household belongings and many accidents occurred. But as Mr. Scott puts it, "You must expect such things if you keep lions as pets." Another fact that Mr. Scott points out is that it is difficult to keep poultry and stock as well as to remain on the best of terms with your neighbors if you wish to keep lions. Mr. Scott prefers the lions.

Not only is Mr. Scott interested in lions as pets but he has spent much of his time in the field hunting and observing wild lions, and a number of chapters are taken up by his experiences. On one occasion, early in his career, he was badly mauled by a wounded lion. Even this did not alter his affection for them. Mr. Scott is also a professional hunter, and parts of the book relate his experiences with big game hunters and photographers.

There is one statement made to which I must take exception. Mr. Scott writes that the cheetah is not a cat but is related to the dog. It is true that, with its long legs, slim body and nonretractile claws, the cheetah resembles a greyhound. These are factors for great speed, and the cheetah, for a short distance, is the fastest of running mammals. It is, however, a true cat of the family Felidae, as can easily be seen by skull characters.

This book is different and makes interesting reading. The numerous photographs of lions out of their natural habitat form one of its chief features.

T. D. C.

JOURNEY TO THE WORLD'S END

by Hakon Mielche, translated from the Danish by M. A. Michael

Doubleday, Doran, $2.50

MR. MIELCHE'S trip to Tierra del Fuego was made solely for the purpose of getting material for this book. His story is well and amusingly written as long as he holds to the account of his own adventures. However, when he tries to describe the country and its people, numerous unfortunate errors occur. In view of the fact that the manuscript was on its way to the publisher within twelve weeks after his arrival at the Straits of Magellan, this is not surprising.

Some of his criticisms of the way in which the sheep farming region has been settled and managed are unwarranted. For instance, he claims that forests have been destroyed to make grassland in a section which has seen no trees since the last ice age, and cites this as proof that the land is wastefully exploited! He is also confused in his use of certain geographical terms.

While taking exception to some of his comments it is also necessary to protest his portrayal of Fuegian weather. It sounds very much as if he were trying to satisfy the expectations of his readers when he writes that it has "one of the coldest and severest climates in the world," and of monthly temperatures "well below the freezing point" the year around. This might be true if applied to Fuegian mountain crests lying above the line of perpetual snow, but such statements are no more accurate than they would be if used in speaking of the climate of Mexico or Switzerland.

Also misleading are his remarks on the present and former Indian population, particularly the references to the Alaculuf tribe.

It is a pity, in view of Mr. Mielche's ability as a writer, that he has not been more accurate.

JUNIUS BIRD.

LETTERS

Continued from page 182

SIRS:

The article "Canine Fishermen" by E. W. Gudger in the last issue was most interesting to me, as I am sure it was to your other readers. An unusual subject told with clarity and vividness, and well illustrated, is a recipe for successful writing.

Permit me to suggest that other articles along the same line would probably be welcomed by your subscribers.

JAMES R. DANIELS,
Associate Editor.

Sales Management
New York, N. Y.

* * *

SIRS:

Most of the readers of NATURAL HISTORY Magazine have probably never seen a fossil of a jellyfish and may be surprised to know that a record of this most delicate creature of the sea could be preserved in the rock for 80 million years.

On one of our usual week-end exploration trips, my wife and I discovered our first specimen of these rare fossils, more than six years ago. It resembles a deep imprint of a large seven-petaled blossom. It was something new to us, entirely different from any fossils described in the literature which we had on Texas paleontology. We soon guessed that it was the outline of a jellyfish, although different from any jellyfish we had ever seen. When I sent samples to Dr. R. S. Bassler of the United States National Museum, he stated: "This is a very interesting fossil, and you are quite right in believing it is a jellyfish. It represents the imprint in sand of a fossil jellyfish, but its more definite classification cannot be given until a detailed study of such forms has been made. In Europe fossil jellyfishes very similar to this have been described from the celebrated Solenhofen lithographic limestone of Jurassic age."

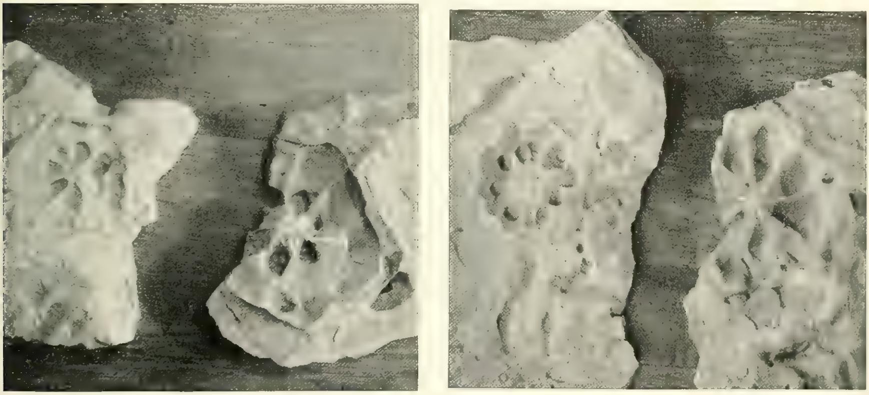
The time when these creatures lived was more than 80 million years ago, the Age of Dinosaurs, when most of Texas was covered with the shallow Comanche Sea. Apparently the fragile jellyfishes were washed ashore by the tide and, being covered by sand or soft mud, left their impression in the material which later became rock.

The area near Roanoke, Texas, where we found these is only about three miles long and less than one-quarter mile wide. The fossils are extremely rare, and one must examine the sandstone slabs carefully on both sides to find them. The imprints vary in size from one inch to four and one-half inches; and the number of lobes around the center varies, with seven about the average. There are two types: one with a single row of lobes, the other a double.

All the prints seem to show the lower side of the animal, and the question therefore arises: why did none of the animals come to rest on their backs when they settled into the mud? This is only one of many questions about these fossils, but it is the thrill of discovering and attempting to read these stories in stone that makes fossil-hunting one of the most fascinating of outdoor hobbies.

FORREST KIRKLAND.

Dallas, Tex.



WHY NEVER ON THEIR BACKS? *(Above)* Fossil jellyfish estimated to be 80 million years old *(Below)* The place where they were found near Dallas, Texas

Photos by Forrest Kirkland

THE SOCIAL RELATIONS OF SCIENCE

by J. G. Crowther

Macmillan, $3.50

SCIENTISTS [illegible] never did live in ivory towers. The long interwoven histories of science and of society's skill [illegible] explained in this book by the scientific correspondent of the Manchester Guardian show that social factors have determined not only the rate but also the direction of scientific progress, which in turn has had a profound influence on social evolution. The present age is characterized both by the cultivation of science and technology and by the intensification of social consciousness and change. No book could be more timely than this, relating the two outstanding characteristics of modern civilization and tracing their parallel development from prehistoric times.

The influence of society on science has usually been restrictive and conservative, that of science on society expansive and progressive. Crowther demonstrates a correlation between the social status of skilled manual labor and the development of science. In a society based on slave labor, intellectual endeavor is barren, science hardly exists, and technology stagnates. As the social appreciation and reward of skilled labor increase, science flourishes and technology advances. The social change favorable to it is accelerated by science which thus tends to improve the status of skilled labor. The process is not without exceptions and it is self-limiting, because it often tends toward a type of social control unappreciative and uncongenial with regard to science, in spite of its basic interdependence with science. Science is not productive in an immediate and material sense, and it requires the use of surplus production from the material producers. When the support is either indirect or compulsory, other things being equal, scientific movement is mainly controlled by scientists and history shows that such control has been justified, on the whole, by ultimate increases in production and in social well-being. But as science becomes dependent on the direct and voluntary support of the great producing masses, it also becomes subject to their control and to their scale of values, which is often inimical to science. This situation is rapidly arising in America and must inevitably arise as a democracy evolves beyond its plutocratic stage. For us the problem is very real and present and in no sense academic.

The obvious, indeed the only, solution is a realization by those in control that their own welfare (both material and cultural) depends on science. Crowther's history demonstrates the necessity of this solution and is a contribution toward that end. The average skilled workman, himself a technician, thinks of technology as "useful science" and of science, properly speaking, is [illegible] science. He supports the support of technology and thinks of this as contributing to the advancement of science, while he may in fact be not merely indifferent but openly antagonistic to such advancement in a truer sense. This confusion of values is conveyed to his leaders and [illegible] still less desirable [illegible] because appreciation of technology is at least felt to be vital for the growth of science, but the support from [illegible] of political conservatives usually understands neither technology nor science. Science and technology are so inseparably related that the confusion is natural, but just because of their intimate relationship the result of deprecating pure science may be fatal not only to science but also to technology. It is a fault of many recent popularizations that most of what they call "science" is really technology. Unfortunately Crowther's book, despite its general excellence and the value of its contribution to this whole problem, sometimes has this fault. It properly discusses the social history of both science and technology, but it fails to make a consistent distinction between them and often means "technology" when it says "science."

The book closes with some discussion of recent efforts by scientists to co-ordinate society and science and has a final minatory chapter on the social responsibilities of scientists. Elsewhere it is made sufficiently evident that the responsibility is mutual. In a book intended primarily for nonscientists, final emphasis on the scientific responsibilities of society would have been more original and more useful. Not the least of the many good qualities of this highly recommended book is that it stimulates thoughtful discussion and presents the materials for informed opinion, whether or not in full agreement with the author.

G. G. SIMPSON.

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Answers to Questions on page 238

[illegible]

THE TRUTH ABOUT THE CUCKOO

by Edgar P. Chance

Scribner's, $4.00

THE European cuckoo has been a legendary bird whose call "cuck-oo," copied for cuckoo clocks, and whose habit of having its young brought up by strangers, were better known than the bird itself.

Thanks largely to Mr. Chance we now know that yearly the same female cuckoo, identifiable by the eggs she lays, returns to the same place and lays her eggs in the nest of some favorite host species, perhaps of that which was her foster parent. The sight of her prospective hosts starting nesting apparently furnishes a stimulus to her laying. When ready she glides down to the nest and with surprising rapidity lays her egg in it. The rest of the story is better known; the host cares for the young, and the young cuckoo ejects the rightful young.

How Mr. Chance found out all this is a story of boundless energy and perseverance. He knew his cuckoos personally, found all the nests of possible hosts, and conducted experiments on them. Finally he could predict when and where some of his cuckoos would lay their eggs and at his invitation many bird watchers witnessed this. He made a commercially successful motion picture, *The Cuckoo's Secret*, in 1921, and the next year published his book of the same title. The present volume is a revised edition, with additional material. Mr. Chance seems not to believe in evolution, but invokes natural selection to explain minor points. His section on mating is largely speculative and some of his suggestions, such as that cuckoos exert mesmeristic influence on their hosts, and that the host is "under orders" to care for the cuckoo's offspring, are not very attractive. However, this is minor, and his studies represent a great advance in our knowledge of the truth about the cuckoo.

A. L. RAND.

May

NATURAL HISTORY

1941

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OLUME XLVII. No. 5

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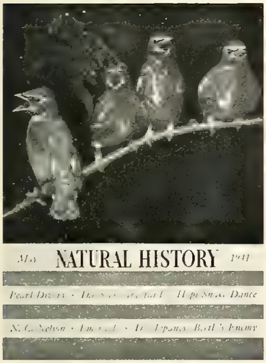
Above illustration painted by F. L. Jaques, from Bird Group of Hudson Bay Region in the American Museum of Natural History

LETTERS

THE COVER THIS MONTH

The young cedar waxwings on the cover of this issue, photographed in Kodachrome by Dr. Olin S. Pettingill, Jr., were nestlings about sixteen days old. At the time, the writer was working on a life history study of this bird at the University of Michigan Biological Station, and had removed these young from their bulky, cuplike nest for closer observation. They were able to undertake short flights at this age.



As they clung tightly to the branch, the young waxwings stretched their wide mouths upward, as though engaging in a mock feeding exercise, and flapped their wings eagerly, appearing ready for a take-off. Preening and stretching, the restless nestlings occasionally strengthened their bills by chewing against the branches and by pecking at each other.

When I handled them, the young all showed pugnacity toward me by striking my fingers with their bills and lisping belligerently behind their bold, black masks. They made gourmands of themselves as they feasted on the pin cherries. When they left the nest two days later they weighed several grams more than the adult waxwing, and when 20 days old were able to fly very well.

ROBERT B. LEA.

* * *

SIRS:

I have long admired your magazine NATURAL HISTORY and I am one of your cover-to-cover readers. . . .

WILBUR FORREST,
Assistant Editor.
New York Herald Tribune
New York, N. Y.

* * *

SIRS:

As a two-year reader of NATURAL HISTORY Magazine, I deeply appreciate your effort in spreading to many interesting and unheard of facts concerning nature and the world in which we live. Your excellent articles, as well as the splendid illustrations, make NATURAL HISTORY the world's outstanding magazine in its field, and I am very sure that all the ones who ever started reading it will never feel like giving it up. . . .

CHARLES CHESSEX, D. D. S.
Lausanne, Switzerland

* * *

SIRS:

NATURAL HISTORY is without doubt the finest magazine of its kind in the world. It is very highly praised by my school teachers and friends. The pictures in the Magazine are very good material for school use, as they cover practically every subject.

I especially liked in the January issue "Indian Sign Language" and "A Pet Walrus." Also in the February issue, "A Lynx in the Home."

I think you could improve your magazine by having more interesting back covers such as on the February issue.

EDWIN KESSLER.
Far Rockaway, N. Y.

* * *

SIRS:

I appreciate your magazine very much. I love science, and this magazine is the best I have ever read on that subject. I enjoy the rich covers and interesting articles and photographs. I find NATURAL HISTORY valuable when I wish to find out about certain subjects for a topic.

BARBARA FAY.
Cambridge, Mass.

* * *

SIRS:

In the November number of your excellent magazine there was a series of unusually good photographs of the Philippines, with a short text by Fenno Jacobs. The character studies and the views of the Ifugao rice terraces were particularly fine. There is an error, however, in the description of the rice terraces. They do not serve as catch basins for rain water. The water supply comes from a series of springs near the crest of the ridge between Bontoc and Benaue. Elsewhere the rice paddies are either down in the streambeds or in positions where water may be led to them by means of simple ditches or bamboo pipes, not because of lack of skill in building terraces but because the planting season comes just before the rains. The paddies must be soaked thoroughly before cultivation, because all the work on the upper levels is done by hand. . . .

The article in the December number on the Angel Falls was very interesting. E. Thomas Gilliard might like to check up on a curious discovery I made a few days ago. I had picked up an old work *(Die Erde und ihr Organisches Leben,* Part II) in Manila, published apparently about 1880, and leafing ahead of the place where I was reading I found a quarter-page steel engraving on page 468 with the fol-

Continued on page 304

THRILLS GALORE IN
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Scenic wonders and pleasant experiences pass in gay succession in the romantic West—the Rocky Mountain region of Colorado with its snow-capped mountains, pine forests and rippling streams; the wild life and natural phenomena of Yellowstone; the ocean, redwood forests and movie colonies of California—these and countless other attractions make the West the mecca of summer vacationists.

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HABITAT GROUPS IN COLOR

By CHARLES H. COLES

[illegible]

THE [illegible] habitat groups in the American Museum of Natural History [illegible]

The striking compositions and wealth of detail in the large habitat groups in the Akeley African Hall and in the Asiatic Hall have daily attracted large numbers of amateur photographers. A large percentage of their pictures are being made with color film, which makes us wonder just what results are being obtained. From our own experience it would seem that such pictures can only suggest the real beauty of the scenes—certainly not a true color rendition.

Color errors

One reason why the results can only approximate the actual colors we see in the habitat groups is because of the color balance the manufacturer has incorporated in the film. We would not, of course, use a film adjusted for daylight on these groups, because they are illuminated by incandescent lights. Furthermore, we should not use Kodachrome "A" because it is balanced for the bluish-white light of photoflood lamps.

Suppose that we were to make a picture of a group with type "A" film. Because the illumination in Akeley African Hall comes from ordinary incandescent lamps, which have very little blue in proportion to their yellow light, the picture would come out lacking in blues. The entire picture would look yellowish-brown, with the blue sky a sickly greenish tone. Naturally the effect is untruthful and not very pretty.

Since there is no other film to use for artificial light (except the larger size sheet films), some means will have to be used to correct the color of the light. In technical terms, we have to increase the color temperature of our light source. We in the Museum have made numerous experiments on the habitat groups and have found several ways in which to improve the color rendition of them.

Color correction

The first step is to use a faint bluish filter over the lens, thus correcting the yellowness of the lamps. The best filter for this purpose is called a W&W CC—6 Color Correction Filter. The use of this filter cuts your light down by about half, so you will have to give the scene twice as much exposure as you would without it.

The next step in making better color pictures is to confine your range to a small part of each group. In this way you won't have to struggle with irregular light intensities. The sky is usually from four to ten times brighter than the foreground of a group. [illegible] range for Kodachrome [illegible] either the foreground or the sky will suffer in color rendition. If only a small part of the sky is permitted to appear in each scene, the proper exposure for the foreground may be given and the sky allowed to overexpose.

Take pictures of animals that are near the background of the group. These animals receive better illumination on the front and under sides of bodies than those in front.

Exposure problems

If you insist on photographing the whole group at once, reconcile yourself to the trial-and-error method for determining exposure. So far we have found no simple relation between exposure meter readings and the exposure that we have found to give the best results. For some of the groups the geometrical mean intensity of the highlights and shadow readings may form the basis of exposure calculations; but if your meter or your mathematics is not up to that, you'll have to "cut and try."

If you're conservative enough to take only a portion of the group, take your meter reading on that part of the group to be photographed. On very dark groups representing forest interiors, give twice as much exposure as the meter indicates. Kodachrome is not very sensitive to green.

For the greatest realism, use a fairly large lens opening so that the background is permitted to go slightly out of focus. Then you'll really fool your friends when they see your pictures of wild animals of darkest Africa.

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THE FREE MIND

TODAY, as never before in modern times, we see the biological principle of "survival of the fittest" distorted into an excuse for mass brutality in total disregard of all the spiritual aspirations built up since the prototypes of modern man appeared in the Glacial Period. "Superior race" is the creed on which Hitlerism thrives. The aim of emergence of species, including man, through ruthless competition is glorified, although co-operation in nature has been demonstrated throughout the ages. Thus we have seen in a dictated Europe the regimentation of the schools, the elimination by death or ostracism of all intellectually honest teachers and leaders, the closing of colleges and universities, the burning of books, and the destruction of museums.

The struggle of the democracies against the dictatorships is not only a fight for freedom to live, a fight to satisfy physical and emotional hunger, but it is just as importantly at present, and even more importantly for the future, a fight for the freedom to think.

In this struggle the museum stands at the forefront of the institutions designed to satisfy intellectual hunger. The museum is not limited like the public school to the young. The museum is not dedicated like the college or university solely to the educated. The museum does not, like the library, serve only the literate. The museum deals with all peoples on all levels and can and does reach out to meet the intellectual hunger of all people of every degree on all levels of intellectual attainment. It is a democracy's most important agency for the spread of honest understanding of life.

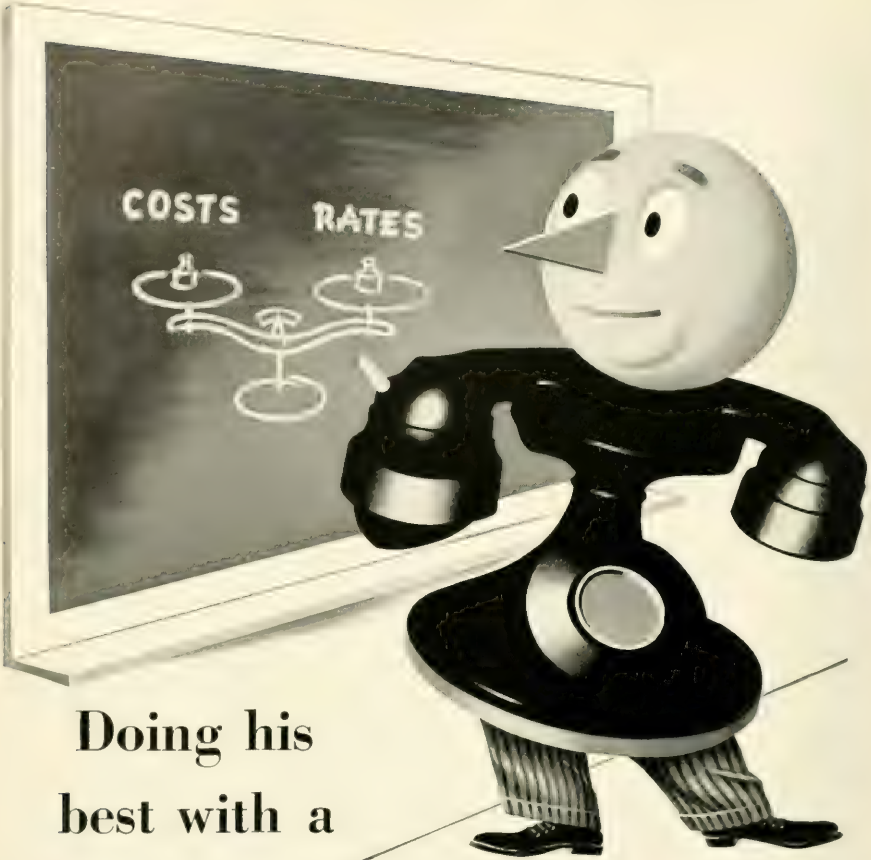
During a period when measures of defense of freedom and democracy take shape in the training of men and the production of materials, we must not let the fact be forgotten that in the end the surest defense for democracy is an enlightened people. To this end all possible springs of knowledge must be enlarged and the channels of information deepened so that understanding may flow unimpeded to all people who hunger for it.

A distinguished geographer said, "Man alone of all creatures is able to worry about the future and to make provision for meeting problems for which he did not inherit a solution." In other words, man has the unique privilege of being able to think out his own salvation. The real work of the museum is to help people to think in terms of realities and not theories.

The Museum is the one center in which the mighty record of life is preserved. To obtain this record and to house the specimens adequately against the time when many of the species will have vanished from the earth has been, and is, a motivating force of the institution.

But just as important is it to use these vast collections effectively not only for the benefit of pure science but for objective teaching in its exhibition halls. Our chief concern is to meet the needs of a changing and chaotic world in what we teach and how to teach it.

FROM THE ANNUAL REPORT OF THE PRESIDENT,
THE AMERICAN MUSEUM OF NATURAL HISTORY



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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Roy Chapman Andrews, Sc.D., Director

VOLUME XLVII—No. 5 ★ ★ ★ ★ ★ ★ ★ **MAY, 1941**

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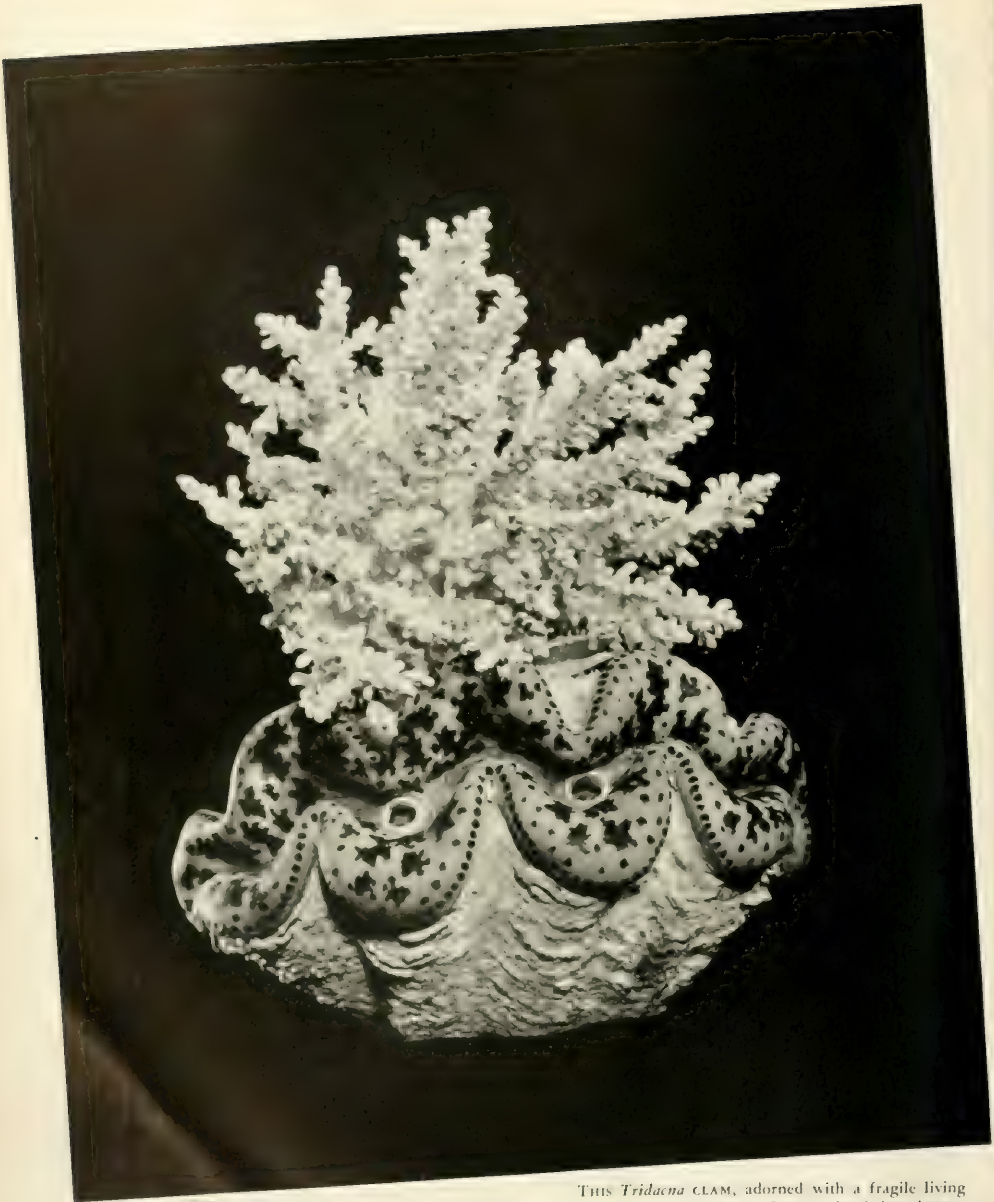


[illegible]

THIS *Tridacna* CLAM, adorned with a fragile living coral, grew on the lagoon floor, 25 feet below the surface. The photograph represents the animal modeled in wax within the actual shells so as to display its gorgeously colored mantle edges, which, in life, expand over the scalloped shell margins

PEARL DIVERS

By Roy Waldo Miner

Curator of Living Invertebrates, The American Museum of Natural History

An account of an American Museum expedition to the South Pacific to obtain material and data for a new group in the Hall of Ocean Life depicting the undersea activities of the Polynesian natives in their traditional search for the treasures of the deep

The *Zaca* was lying at anchor off Penrhyn Island, called Tongareva by its native inhabitants. A stiff breeze, blowing over the land from the east, raised dancing multitudes of whitecaps, their snowy crests contrasting strongly with the deep ultramarine of the tropic sea. The white strand of the distant shore, disappearing and appearing alternately as the foaming breakers dashed against it, was crowned with long lines of coconut palms tossing their green plumage as the trade wind swept over them. Midway, their verdant line was broken by two shelving points, bare and rock-strewn, that seemed nearly to meet on either side of the narrow West Pass, the only practicable entrance for our vessel to the sheltered lagoon of the coral atoll.

As we watched, a sail appeared in the opening, delicately threading the tortuous channel, and headed for the open sea. It was followed by another and another, and finally a multitude of craft, obviously smaller than the leading vessel, emerged from the opening and shaped their course directly toward us before the wind.

Examining them through our glasses, we saw that the larger boat was a sloop, flying the blue of the British colonial ensign, and realized that we were to receive an official call from the Government Agent in charge of the island. As the fleet drew nearer, we made out that the smaller vessels were numerous outrigger canoes, their single sails manipulated skillfully by their Polynesian navigators. Soon they arrived alongside, and, as the Agent, Philip Woonton, came aboard, the owner of the *Zaca* and sponsor of our expedition, Mr. Templeton Crocker, met him at the gangway and escorted him aft to meet us. Almost immediately, the dusky-skinned natives swarmed over the gunwales, examining the vessel and fraternizing with the sailors forward.

Philip Woonton, clad simply in jersey and white trousers, with a native broad-brimmed straw hat shading his swarthy face, greeted us hospitably. Mr.

Frank Tiaga, Samoan sailor from the *Zaca,* equipped with water-tight goggles, diving for corals. Through his efforts many of our finest specimens were secured, including the great 900-pound coral shown on page 261

Photo by Wyllys R. Betts

(Left) THE GRACEFUL POWER-SCHOONER, *Zaca*, which carried our expedition to the South Seas, riding at anchor outside the atoll of Tongareva, while waiting for a native pilot

(Right) THE *Spray*, official boat of the British Government Agent, Philip Woonton, emerges from the Tongareva lagoon to welcome the expedition to the island

(Below) THE *Zaca* under way toward the West Pass, the difficult lagoon entrance, guided by a skillful native pilot. Mr. Crocker, Mr. Woonton (in broad-brimmed hat), and other members of the Museum party are standing near the after rail

(Left) Native outrigger canoes being towed astern as seen from the masthead. Their native crews are aboard the *Zaca* curiously examining the vessel and fraternizing with the sailors forward

(Below) The native village of Omoka nestles beneath groves of coconut trees on a point of land inside the circle of the lagoon. The *Zaca* came to anchor beyond this point

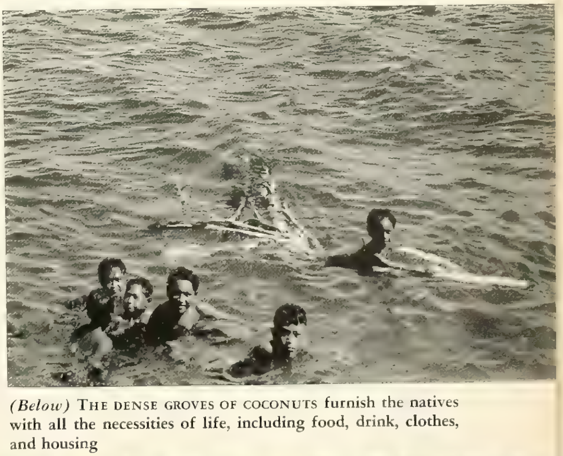
Photos by Toshio Asaeda

(Below) Native boys, supported by half submerged branches of trees, swam around the *Zaca* for hours, curiously watching our movements

(Left) The narrow native canoes are made from scooped-out tree trunks with plank gunwales fastened on by twisted cords of coconut fiber. Outriggers keep them from capsizing when under sail

Photos by Roy Waldo Miner

(Below) Tongarevans cleaving coconuts on sharpened stakes. The coconut meat is dried to make copra and sold to passing trading schooners. It is eventually used for making confectionery and soap



(Below) The dense groves of coconuts furnish the natives with all the necessities of life, including food, drink, clothes, and housing

Crocker handed him our credentials, including a letter of introduction from our friend, Dr. Peter Buck, the Director of the Bishop Museum at Honolulu, who had previously spent much time on the island studying its inhabitants, and had established most cordial friendship with him. This settled the matter and we were informed that the entire island and its inhabitants were at our disposal.

When Mr. Woonton learned that the purpose of the expedition was to make a study of the pearl oysters, which, Dr. Buck had said, abounded in the lagoon, with the view to building a group in the American Museum representing the native divers in the act of gathering them, he became quite enthusiastic and assured us of every assistance in his power.

His most experienced native pilot was then called on to the vessel, and soon our engines were driving the *Zaca* against the wind toward the narrow entrance, towing behind us Mr. Woonton's boat, as well as a long line of the native dugouts, attached tandem fashion to our stern.

A narrow opening

Very shortly, we were tossing in the midst of a swirl of conflicting currents and foaming whitecaps, as we negotiated the narrow and perilous entrance channel, and then, suddenly, we were quietly riding in the calm turquoise waters of the lagoon. Under the guidance of our pilot, we skirted the luxuriantly green inner shore, rounded a point of land, and soon were floating at the anchorage assigned to us. Opposite lay the picturesque little native village of Omoka, with its simple dwellings nestling under dense groves of coconuts that seemed to crowd every inch of available space. As soon as we had rounded the point, all the inhabitants, men, women, and children, came crowding down to the shore and even invaded the water, paddling around us in their canoes or bobbing about the boat as they swam as near as they dared—for Woonton had warned them to keep at a respectful distance.

Tongareva is a typical atoll, or ring-shaped island of coral, surrounding a central lagoon, one of many such beautiful formations in the South Pacific Ocean. It forms a large oval, eleven miles through its greatest diameter, composed of a series of long, narrow islets, called *motus*, connected by stretches of coral reef, awash at low tide, and absolutely impassable for boats. The waves of the open sea dash against the outside of these reefs with considerable violence, rushing through into the lagoon at high water.

Coral atolls are usually most accessible on their western side, many of them having but this one entrance. Some, however, are completely landlocked, with lagoons that can be navigated only by small boats or canoes carried across the barrier by hand.

All the *motus* of Tongareva are covered with dense growths of tropical vegetation, mostly coconuts. The plantations are almost over-dense, for the natives refuse to thin them out, believing that the value of their land depends on the number of coconuts growing on it. These remarkable trees do not have to be cultivated, as they spring up without any trouble on the part of the inhabitants. They furnish the natives with the material for houses, clothing, mats, produce fish nets, food and drink, so they cannot be blamed for considering them as the foundation of their well-being. In fact, the coconuts have also brought the Pacific Islanders a measure of prosperity. For they dry the meat of the nuts to make copra. This is exported in large quantities for the manufacture of soap. The lagoon abounds in tropical fish of all kinds, which form additional food resources, as the islanders are expert fishermen. Finally, Tongareva, like many other Pacific islands, produces the precious pearl oyster, the iridescent shell of which secretes mother-of-pearl and is sold by the ton to trading schooners, to be used for knife-handles, inlays, and pearl buttons. Occasionally, a shell is found which yields a precious pearl, often of great value, enriching the finder, the middleman, and the merchant. As we have said, it was to study these pearl oysters in their native environment that we came to Tongareva.

We found the Tongarevans intelligent and cooperative. They are of the Polynesian race, said, with good scientific authority, to show certain Caucasian traits, doubtless having spread hundreds of years ago into the Pacific Islands from southeastern Asia. There were between 450 and 500 native inhabitants on the island at the time of our visit, mostly living in two villages at opposite ends of the lagoon, known as Omoka and Tetautua, respectively.

Exploring the bottom

Mr. Woonton assigned two natives to us,—Tau, who was the "policeman" of the village, and Toni, a young boy. Both were excellent swimmers and divers, and Tau, particularly, knew all the reefs and shoals intimately.

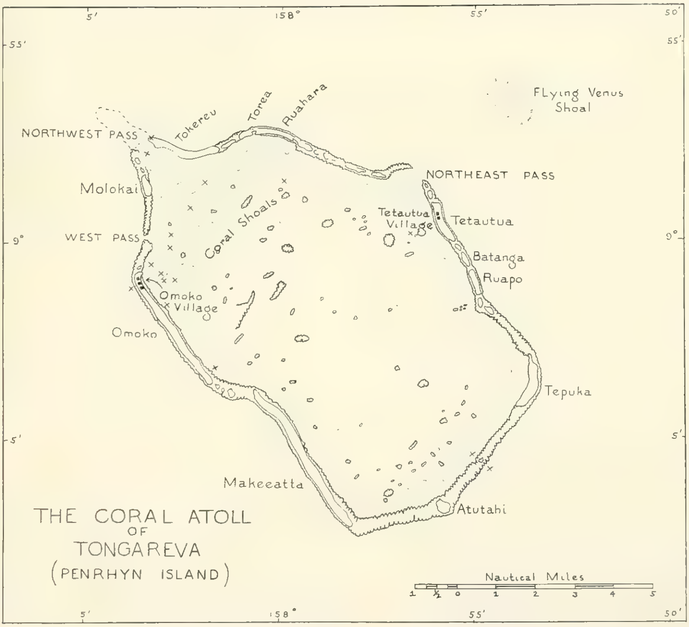
Under his guidance we spent the first two or three days exploring the region in one of the *Zaca's* launches, especially around the coral shoals in the western part of the enclosed lagoon. The waters were very clear, and, using waterglasses (buckets with a glass bottom), we could see the sea floor very clearly for 60 feet or more, and thus were able to pick out the best localities for our undersea investigations. On the third day after our arrival, we were all ready and had our equipment put in order for the work. We then started in earnest and, as we had good weather, we kept on for nine days without a break.

Our method was as follows. Two boats belonging to the *Zaca* were put at our disposal. One of these, an "otter boat," was a small and handy motor launch; the other was a dory. The otter boat carried our photographic equipment,—cameras, undersea camera boxes, and photographic films—, in charge of René, the radioman. Also, Toshio Asaeda, the Japanese artist and photographer of the *Zaca*, was installed here with his sketch blocks and colors, with John, the first mate, as navigator. The dory was reserved for the diving equipment. In it were the two diving helmets with their pumps and hose; the special undersea camera tripods and the hand nets; also, the "bang-bang" (to be explained later), the waterglasses, and the brass-rope ladder. Betts, Olsen, and I occupied this boat with the two sailors who were to man the pumps.

We arrived at our location alongside one of the many shoals. These are interesting growths of living coral composed of many species which, by their combined activity, had grown up from the lagoon bottom, at first as clustered pinnacles, then as broadening columns, which spread out their flat, mesa-like tops within a foot or two of the water surface. The top and sides of these castle-like limestone structures are made up of fragile branching colonies and massive domes of living coral of soft contrasting colors.

The anchors of the dory were thrown out across the top of one of these shoals, thus securing it fore and aft. The otter boat was then lashed parallel to the dory on its outer side. The brass-rope ladder, with rungs one foot apart, was unrolled over the gunwale, to which it was fastened at the top, the lower end trailing over the sea floor 20 or 25 feet below. I was always the first to go down. I stood on the ladder, submerged to my shoulders, while the diving helmet was lowered over my head. The pump was started, and when I felt the stream of fresh air entering the helmet and the comforting clank of the pump beat near my ear, I descended the ladder. Immediately, the 65-pound helmet completely lost its weight as it submerged, and I myself seemed as light as a feather. I climbed down, rung after rung, swallowing as I went to relieve the increasing pressure against the eardrums, and stepped off on the sandy sea floor from the twenty-fifth rung, thus measuring my depth from the surface as 25 feet.

I turned from the ladder and saw before me the precipitous side of the shoal, rising above me in terraces, with overhanging growths of fantastic shapes, adorned with the most beautiful corals imaginable in rich purples, blue, browns, saffron orange and green. Their shapes varied from huge rounded domes to the most delicate lacework, interspersed with contorted fingerlike lobes, gathered in clusters of rich rose. Round about me and above my head flitted fishes of the most gorgeous and weird combinations of color and form, many of them reflecting the sunlight like jewels of coruscating brilliancy and changing prismatic hues. The immediate neighborhood was as transparent as air. I could see fully 100 feet in all directions before the gathering luminous blue fog of the watery distance limited my vision. The undersurface of the water above me gleamed with silver, reflecting like a mirror when quiet, and changing into dancing quicksilver when a breeze threw the surface into ripples and waves.

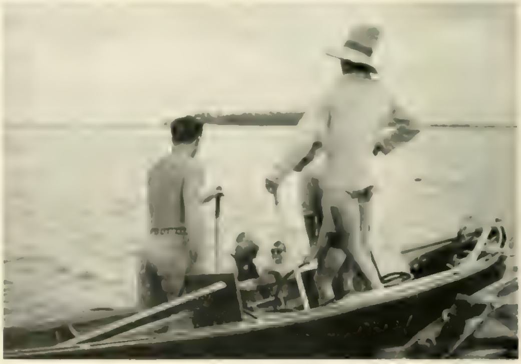


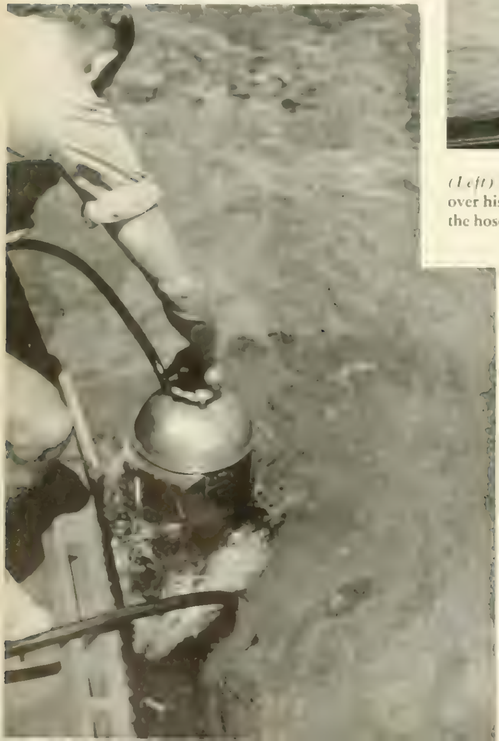
This typical atoll, 2000 miles directly south of Hawaii, is made up of islets connected by half submerged coral reefs, surrounding an eleven-mile lagoon. The crosses mark the coral shoals where the Museum's undersea studies were made

The brawny arms and magnificent chest muscles of Frank, the Samoan sailor, were always at our disposal for sculling our boats and diving for coral specimens, many of which were huge masses dislodged only with great difficulty

Frank's favorite tool was the conventional carpenter's ripping bar, which he used for prying corals from the reef. He is seen above appearing like Neptune from the depths, having climbed to the top of a coral shoal after a 25-foot dive down its precipitous side

(Right) Diving near a coral shoal to which the boats have been anchored. Doctor Miner is standing on the brass-rope ladder waiting for the diving helmet to be placed over his shoulders. Two sailors stand ready at the air pumps. Wyllys Betts (with goggles) swims near by. The boat contains waterglasses, undersea tripods, and other diving equipment





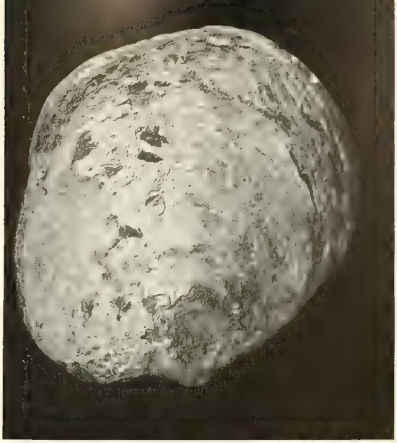
(Left) Doctor Miner goes down. The diving helmet has been placed over his head, the pump started, and the air, entering the helmet through the hose, keeps the level of the water below the diver's chin. Though the helmet weighs 65 pounds in the open air, it immediately loses weight when submerged. The ladder rungs are set one foot apart. The diver counts them as he descends so as to know the depth at which he steps off the ladder

Doctor Miner at the bottom of the sea. The submarine tripod and the rope ladder are visible beyond him. He is examining a cluster of precious pearl shell

(Right) Tau has just descended with the submarine camera. After placing it on the tripod, he swims to his favorite pinnacle to watch the photographic operations

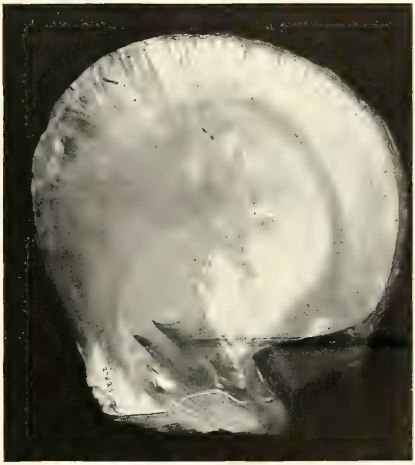
Photo by Toshio Asaeda

(Above) Two divers are down, as shown by the double line of hose, the patches of bubbles, and the shadowy diving helmets visible through the disturbed but clear water



AMNH photos by Coles

Typical Pacific pearl shell. The outside *(above)* is rough and shows encrustations and growth lines. The interior *(below)* is lined with iridescent nacre or mother-of-pearl



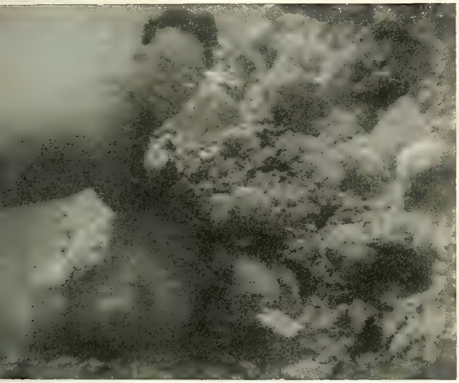


Photo by Roy Waldo Miner

Tau, the Tongarevan diver, has discovered a large cluster of pearl shell and calls the submarine photographer's attention to his find, as he severs the tough byssus threads by which they are attached to the sea bottom. The amphibious Tau stays at the bottom three or four minutes at a time. He rises to the surface at intervals to renew his air supply, returning immediately to his search for the pearl shells which grow abundantly in the lagoon

(Below) Chris Olsen painting undersea. An oiled canvas stretched over plate glass is framed in a metal easel. Oil colors are pressed on with a palette knife

Photos by Roy Waldo Miner

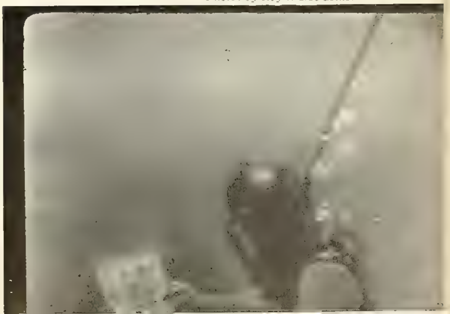
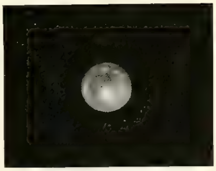


Photo by Roy Waldo Miner



Courtesy of Marcus & Company

A Precious Oriental pearl

PEARL DIVERS

[illegible] half floating [illegible] gently [illegible] and I [illegible]

Undersea photography

The silvery water surface above my head broke, and the legs and square top of my tripod appeared, [illegible] through [illegible] hook at the end of [illegible]. It was lowered with a series of irregular jerks to the sea bottom a few feet away. I made my way over to it deliberately with half-floating steps, allowing the [illegible] watery medium to support me as I did so instead of wasting strength in trying to push it aside. When I reached for the tripod, my hand closed on nothing, for the magnifying quality of the water deceived my eyes in estimating distance. I groped toward it, in full vision, and watched my hand finally close about it like the hand of another person. Slowly I placed the tripod in position; and then I saw, hanging near by, one of the loaded camera boxes with motion-picture camera enclosed. I placed it on the tripod, took note of the distance for which it had been focused chalked upon its side, and signaled with my arm toward the lower end of a waterglass through which John was gazing weirdly down at me from above.

The surface water broke again, and a coil of line, weighted with lead sinkers, floated down to me. I fastened one end of this to the coral growth toward which the camera was pointing and measured the distance to my lens, counting the sinkers which had been attached at measured intervals for that purpose. I adjusted the tripod and camera, pressed the lever that connects with the shutter within, and ran off the film for a motion picture of the submarine vista with the strange and beautiful fishes that came flitting, like actors, across the coral stage. I repeated this in various directions until the film was completely exposed. I looked up to signal again and saw the legs of Tau, the diver, hanging near the boat. I raised my hand, and immediately he let go and sank down near me with another loaded camera box. He set it on my tripod, in place of the first, which I was now holding in my hand. Then he relieved me of my burden, and, with a push of his foot against the sea floor, swam vigorously to the surface, heavy box and all, to deliver it to the waiting hands of John. In a few minutes, Tau was down again and swam over to a neighboring pinnacle to which he clung, so as to watch me at his leisure. He rose to the surface occasionally when he needed air, but he always returned to the same spot to wait until my camera ran down, when he swam over to get it and take it again to the surface. He seemed like a veritable amphibian!

Now, down the ladder, came another pair of legs. It was Olsen, equipped with the other helmet. In his hand he had a nonrustable metal palette, with oil colors arranged around its margin in the conventional manner. When he reached the sea bottom, he waited until an easel of the same metal was lowered, framing a sheet of plate glass with oiled canvas stretched over it. He then carried this outfit a short distance away, set up his easel on a rock, and, standing before it, looking like a hobgoblin in his diving helmet, proceeded to lay oil colors on the oiled canvas, pressing them down with his palette knife, thus painting undersea the color and arrangement of the coral formations!

I turned my camera toward him and made a motion-picture record of this unusual performance.

Octopus

On the sea floor, a short distance away, I now espied a fine cluster of living pearl oysters. I went over and examined them carefully. Returning to the camera, I made a careful photograph of them and of several other clusters which I discovered nearby. I signaled again, and Tau came swimming down. I pointed out the pearl oysters, and he swam over, separated them from the coral rock to which they were fastened by means of their tough byssus, and bore them to the surface in his arms. Meanwhile, all this was recorded by the camera. Olsen had now gone above, and Betts took his place. He came over and touched my arm to draw my attention to the side of the cliff, where an irregular cavern opened above a threshold of coral. A tapering serpent-like tentacle was sliding out over the rounded surface, followed by another and another, all armed with disk-shaped suckers! Immediately behind them a bulb-shaped head erected itself above a pair of baleful eyes, regarding me with basilisk-like stare. I turned to my camera, but the film had run out. I signaled for another, and it was quickly lowered to me. I made the exchange as rapidly as possible, meanwhile keeping an eye on the octopus. While I was thus engaged, the creature slid forward over the coral head, bringing all eight of its tentacles into view. Suddenly it launched forward into the water, bulb-shaped head foremost and tentacles streamlining out behind, and swam over to another ledge a little farther away. Meanwhile, I was struggling to adjust the new camera, but when I had it in position, to my disgust, the creature slipped around the shoulder of the cliff and vanished. Another opportunity lost! However, we later captured several others and were able to study them at close range in the aquarium on the deck of the *Zaca*.

Now for the "bang-bang"!

Many of the gorgeous butterfly fishes, goatfishes, filefishes, and scarlet-spotted tangs eluded all the usual methods of capture, so I had to fall back on this unusual apparatus. It consisted merely of a bamboo pole about ten feet long, carefully weighted and balanced with sheet-lead, and having at its end a couple of dynamite caps. Attached to these, a long insulated and waterproofed electric cord was looped along the pole, passing through my hands, and extending 30 feet upward to the boat, where John sat with a switch box between his knees. I would walk along the sea bottom in my helmet, holding the pole out in front of me, stalking the fish I wanted. When I managed to get the caps about a foot above the head of a gaily colored butterflyfish, I would jerk the cord, as a signal to John, who would then close the switch. There would be an explosion, and the fish would flop over, stunned but not killed. Meanwhile, Tau would be swimming at the surface, with a hand net, watching me through the goggles that he always wore undersea. As soon as he heard the explosion, he would swim down, capture the fish in his net, swim to the surface, and turn it over to Toshio, who was waiting in the launch. The Japanese artist would quickly put the fish into a pail of sea water, where it would soon recover. Meanwhile, he would make an accurate record of its color pattern, while still in its fresh condition, before captivity had caused it to fade, as is often the case. This process was repeated again and again. When we returned to the *Zaca,* Toshio would make finished paintings, utilizing his sketches as data, while Olsen and Betts would make plaster molds of the fish. Later, when we reached the Museum, we made wax casts of the fish from the molds, which could then be colored from Toshio's paintings to make life-like replicas of the fish.

That all can see the diver's world

For nine successive days we made trips of this kind to all parts of the lagoon, according to the plan we had evolved when we arrived. We dove morning and afternoon, staying down in the warm transparent waters as long as we wished. I made more than 70 dives during that period, and Olsen and Betts kept the other helmet just as busy. We took thousands of feet of undersea film, made hundreds of sketches of the living fishes and corals in color, secured scores of pearl shells, ten tons of beautiful corals, and specimens of many other invertebrates, as well as notes of many original observations. While we were working, we saw plenty of sharks, morays, octopuses, and poisonous starfishes, and had some interesting experiences with them, but, fortunately, nothing of a serious nature occurred.

Our largest and finest coral is a beautiful spiral growth weighing 900 pounds and measuring five feet in diameter. This is now a conspicuous feature in the Pearl Divers Group in the Hall of Ocean Life of our Museum. We also photographed the native divers while they were collecting pearl shell and made careful photographic studies of them ashore, from which life-size models were afterward constructed for the group.

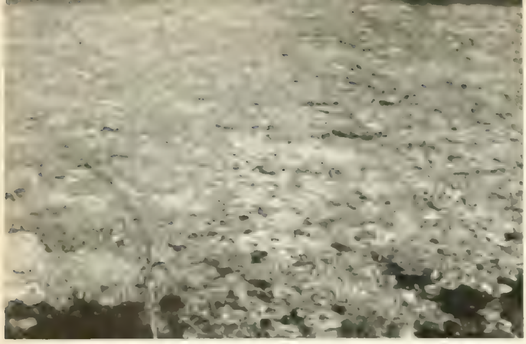
A submarine fairyland

The Pearl Divers Group, which has been built as the result of this expedition, will be completed in a few weeks. It has involved much precise and unusual technique to produce it on the part of the artists and modelers of our Department of Living Invertebrates. It represents two Tongarevan pearl divers plunging down into a coral gorge, faithfully reproduced from one of the magnificent formations that we actually visited on the sea floor of Tongareva. In the midst of this submarine fairyland, they are engaged in plucking precious pearl shell clusters from the ocean bed, daring the menacing octopus sliding out from the entrance of a mysterious sea cave. The divers swim and grope past beautiful and grotesque coral growths to find their prizes among sea gardens of stone flowers, glowing in all the soft colors of the spectrum, while fishes of every gaudy hue dart past them. Beneath the great spiral acropore coral in the center lurks a scarlet, sixteen-pointed sea star with hundreds of poisonous spines menacing from its upper surface.

Among the corals on the bank toward the left, may be seen a bed of furbelowed *Tridacna* clams with sinuous openings, festooned with gaily colored mantle-edges. These are the man-trap clams, to be avoided by the hands or feet of the swimmers, lest the unwary diver be caught and held between the vise-like valves.

Over on the right, the visitor is given an opportunity to peer through a special opening into the Cave of the Octopuses, to spy upon the grisly inhabitants at home, while a vista into the distant waterworld is glimpsed through a submarine tunnel.

The group, as a whole, reproduces a characteristic association of sea creatures typical of the coral reefs of the tropical Pacific and illustrates one of the more primitive methods of fishing for precious pearls.



(*Left*) Upper surface of a shoal of living coral photographed through two feet of water. The anchor rope of the work boat is visible across the shoal at the left of the picture

[illegible]

(*Left*) Edge of above shoal with closer view of the coral growths. The water is so transparent that clusters are visible even at a considerable depth

(*Below*) A living *Tridacna*, the turbelowed or man-trap clam. Between the slightly open valves of the shell may be seen the thin membrane of the mantle cavity pierced by two mantle openings. The oval margin of the left-hand aperture is visible, showing the mottled lining of the mantle cavity within. The thick edges of the mantle, adorned with multitudes of thin, brilliantly blue stripes, are expanding over the scalloped edges of the shell

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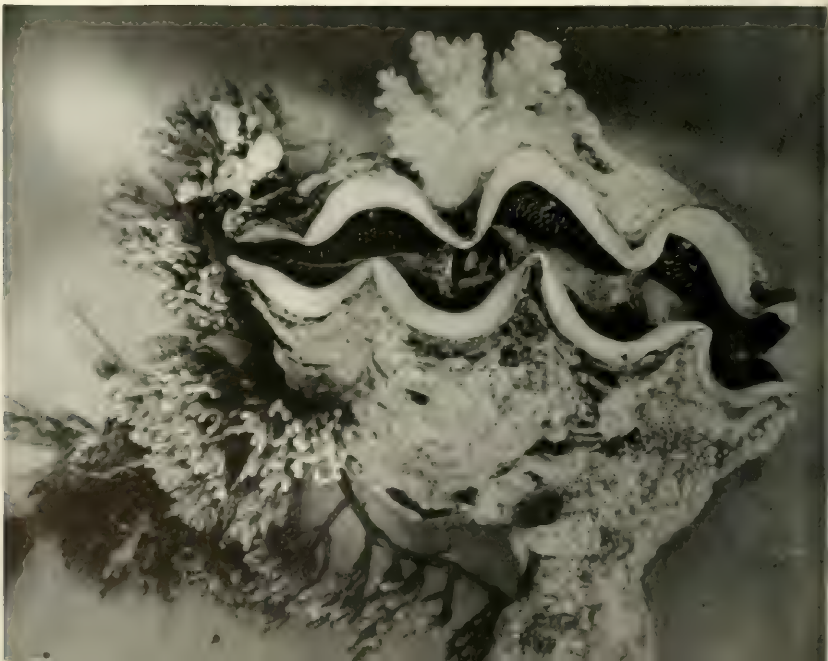
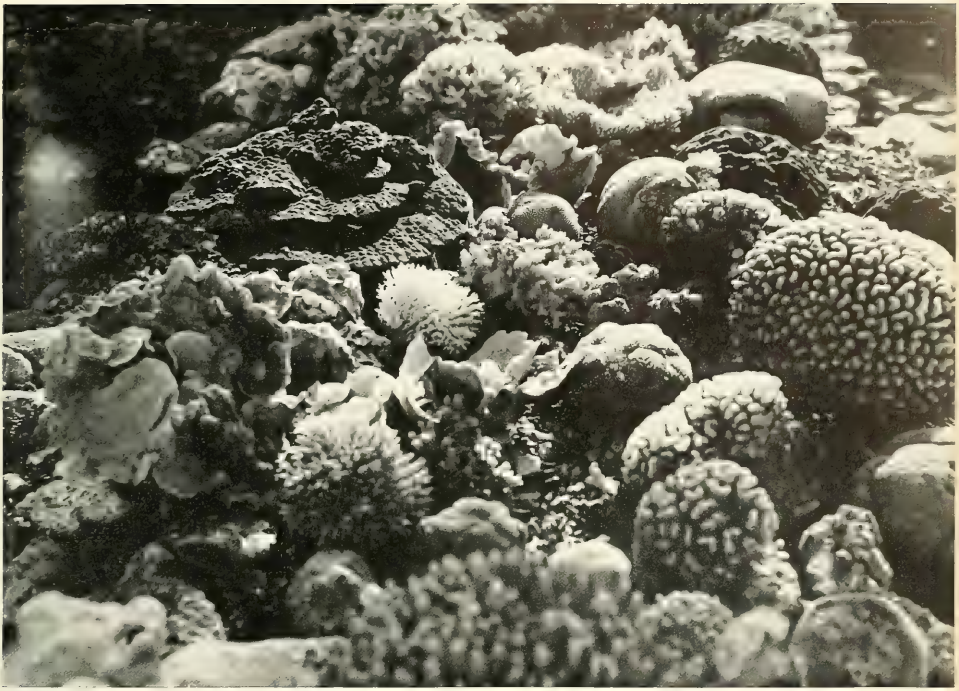
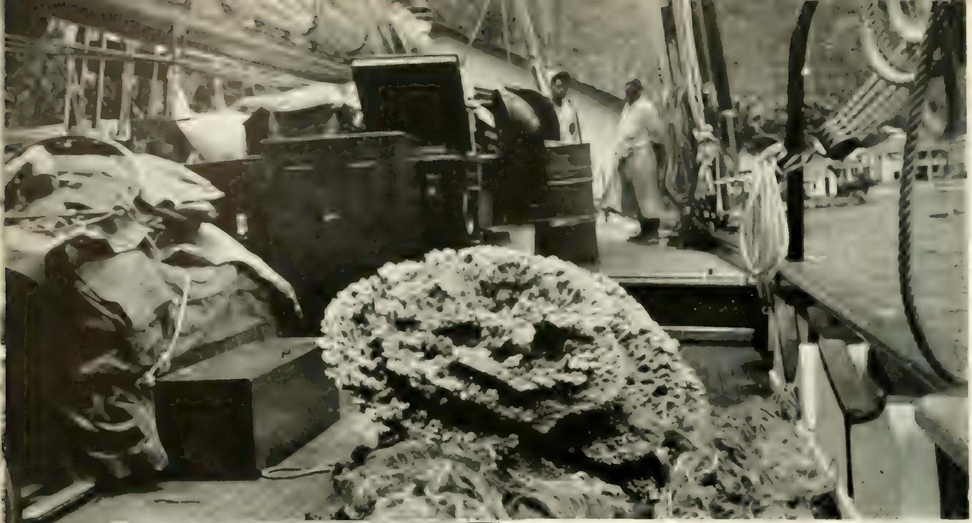


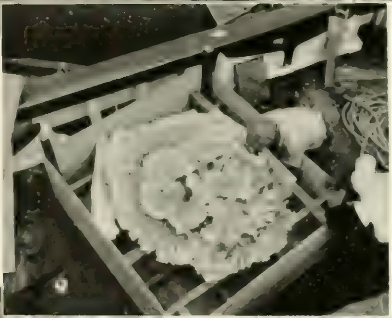


(Above) Part of the coral collection of the expedition, assembled on the dock at Tongareva after having the outer animal tissue removed

(Below) The largest coral collected, weighing 900 pounds. Secured with difficulty by Frank Tiaga and two Tongarevans, it is shown here being hauled aboard the *Zaca* after being brought from across the lagoon. The entire coral mass is five feet in diameter and now forms an important feature of the Pearl Divers Group in the Museum

Photos by Toshio Asaeda





(*Above*) THE GREAT acropore coral specimen aboard the *Zaca.* Its unusually symmetrical form and the spiral character of its growth are well displayed in this picture. This coral, together with the rest of the collection, was brought to Pago Pago, Samoa, on the *Zaca.* Two Samoan natives are seen in the distance

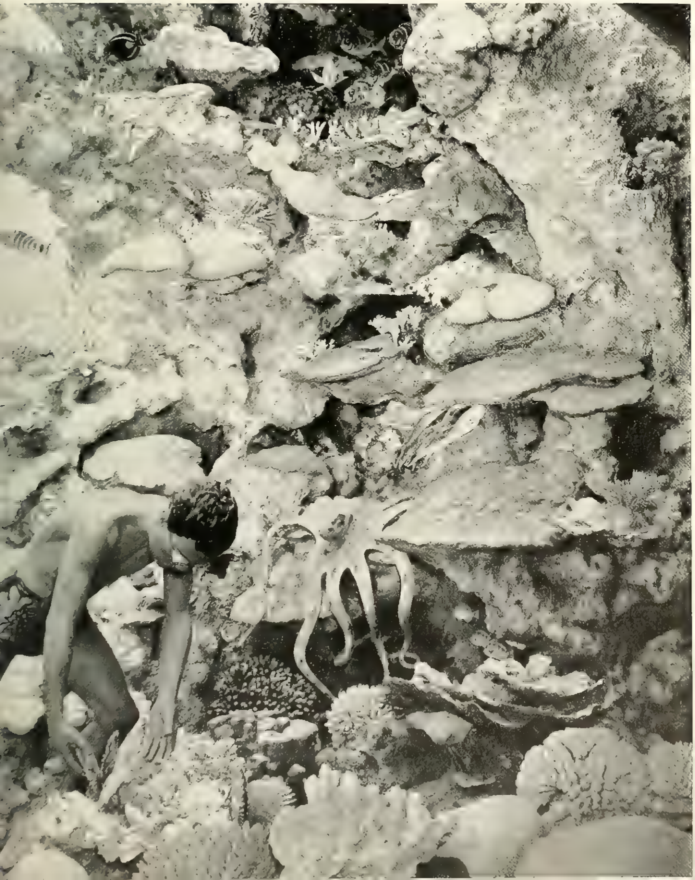
(*Left*) THE LARGE CORAL being permanently packed for shipment to the Museum. Its bottom was carefully secured and the specimen braced against the sides of the box, while they were being built around it

(*Below*) FRESHLY collected corals were brought aboard the *Zaca* at Tongareva, placed in tubs of sea water and thoroughly washed by hosing to remove the animal tissue covering the outer surface. This is known as "bleaching"

(Right) THE COMPLETE COLLECTION on dock at Pago Pago, still roughly packed as it left the *Zaca.* The skilled sailors at the Naval Station carefully crated the entire ten tons of material for shipment to the United States. The collection included corals and hundreds of pearl and *Tridacna* shells. In the foreground may be seen plaster molds made directly from the fishes collected for the group

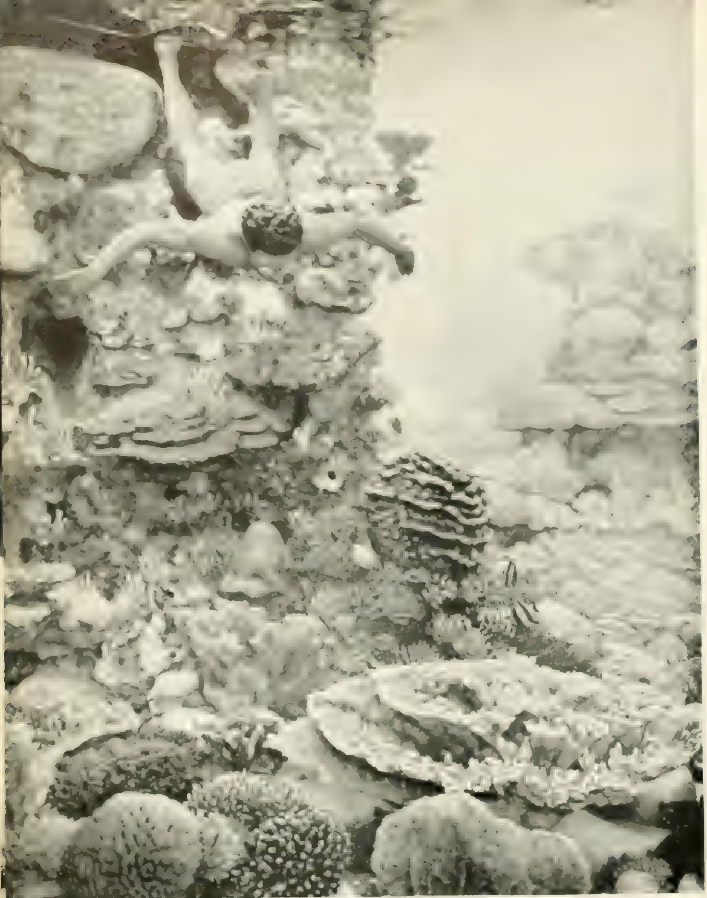
Photo by Toshio Asaeda

AMNH photo by Coles



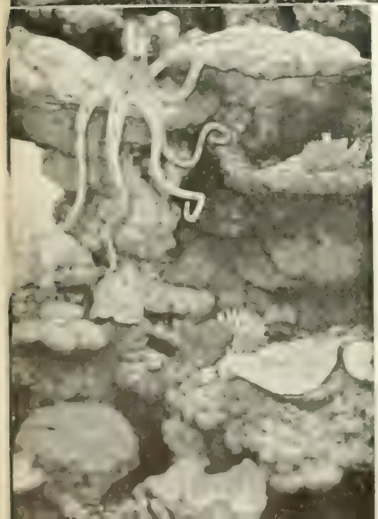
(Left) A DETAIL of the completed Pearl Divers Group. A native diver, equipped with goggles and simply clothed in a *parieu* twisted about his loins, is detaching clusters of pearl shell from the sea floor at the bottom of a beautiful gorge in the lagoon of Tongareva. Near by, an octopus glides out from a crevice overarched by precipitous walls of fantastically eroded limestone covered with delicately branching growths of coral, alternating with massive domes and grotesquely weird foliations. Brilliantly colored fishes flit in and out of the sea caves

The group was constructed, under Doctor Miner's direction, by Chris E. Olsen and Bruce K. Brunner, assisted by Dr. George H. Childs and Worthington H. Southwick. The life-size figures of the pearl divers were modeled by John W. Hope



(Left) A NATIVE gracefully plunges into the depths of the coral fairyland in search of pearl shell. The spiral turret of the great acropore coral, the prize of the collection, is shown in place in the lower right-hand corner of this view of the finished group

(Above and *below)* CAREFUL photographic studies were made of the Tongarevan natives from which the Museum sculptor constructed the life-size figures of the divers



(Left) Through an opening at right side of the Group is depicted a vista through the cavern of the octopuses. A grisly individual is gliding menacingly down from the rocks above

The expedition was made possible by Templeton Crocker and his yacht, ZACA. The group itself is the gift of the late Edith Haggin de Long.

The expedition personnel consisted of Doctor Miner, Wyllys Rosseter Betts, Jr., and Chris E. Olsen.

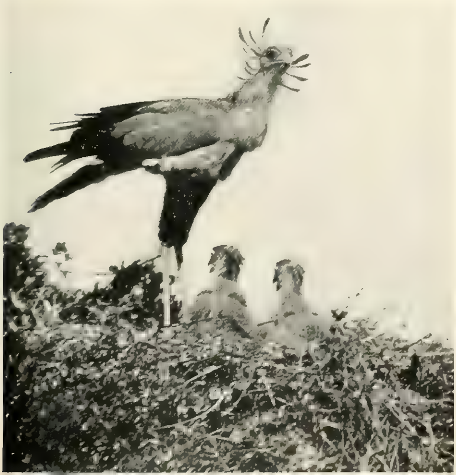
THE "HIDE" from which Captain C. W. R. Knight photographed the family activities that went on in the secretary bird nest visible at right. The nests are usually far more inaccessible and well-nigh impossible to photograph

SNAKE KILLER OF AFRICA

The camera of a celebrated nature photographer catches the secretary bird at the nest with its young,—possibly the first pictures ever taken of this curious creature at home

By CAPTAIN C. W. R. KNIGHT

WHENCE the secretary bird got its name: a pose illustrating the curious elongated feathers at the back of the neck which were supposed to suggest the quill pen protruding behind the ear of the old-time secretary



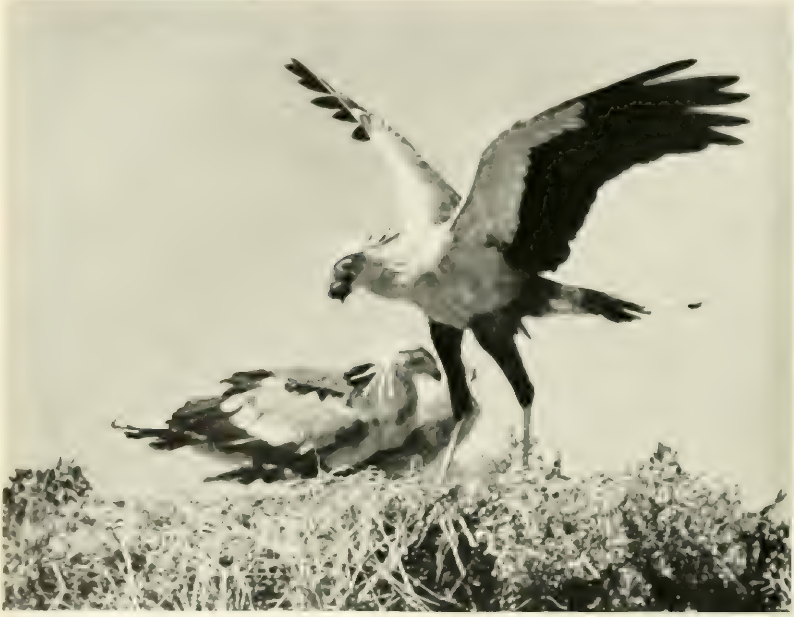
ONE OF the best-known and most interesting birds of Africa, the secretary bird *(Sagittarius serpentarius)*, cannot fail to compel the attention of any intelligent observer, be he ornithologist or layman. This unique bird differs from the eagles and the vultures (to which it is allied) in one curious characteristic—that of killing its prey by forceful and rapid blows or "kicks" of its outspread foot.

In spite of its reputation as a great snake killer—a reputation which, by the way, is fully justified and ought to ensure its survival—the secretary bird is gradually becoming rarer. Egg collectors in various parts of the world, ready to give big prices for its eggs, have fired whole districts with enthusiasm for the treasures. Colored folk have (once to my personal knowledge) wrung the necks of well-grown young ones and taken them home to provide a Sunday roast; while hunters, lacking interest in the bird life of the country and ready to take a crack at any sizable target, will sometimes delight in putting a sudden end to the life of this destroyer of serpents.

The secretary bird shown in the accompanying illustrations was, indeed, under sentence of death [illegible] pions, or locusts.

[illegible] New York [illegible] when in South Africa under the auspices of the Na- [illegible] ous toil over bad stretches of country before we located this nest. We had, indeed, found three others, but all were in positions photographically impossible, [illegible] The nest on which we concentrated was in an almost ideal photographic position, and domes- [illegible] incident.

[illegible] for some time after they had left the nest: saw them doing their ex- [illegible] side- wise, indulging in longer and higher flights, and [illegible] and devoted [illegible]



THE SECRETARY BIRD as an interior decorator. Difficult to understand is the habit of the secretary bird of littering its home with pieces of horse dung, much after the manner in which eagles decorate their nests with tufts of greenery. The mature female is shown here bringing the material in her beak

(Right) A CLOSE-UP of the young in the nest. The secretary bird's favorite decoration is here in evidence

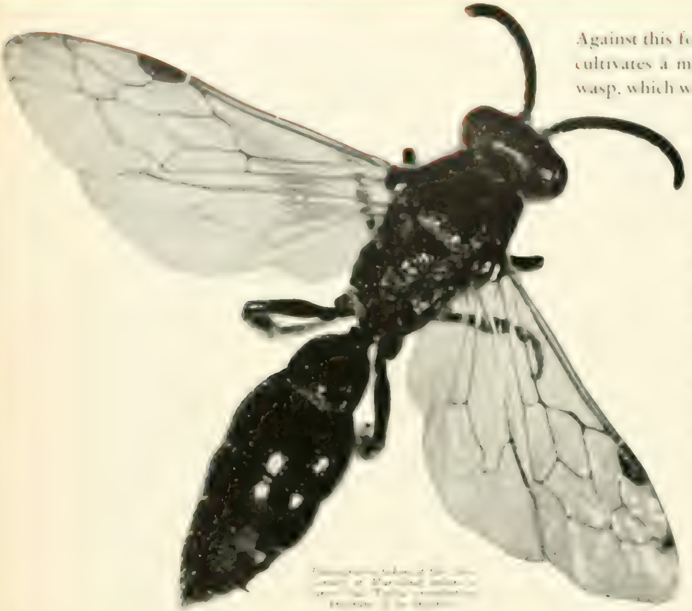
(Above) An Enemy of the secretary bird: a pied crow, arriving on the nest to devour the eggs

(Right) A Lizard for the Family. The secretary bird's long legs, so effective in killing prey, enable it to walk extremely fast. The observer may run at top speed, but the bird, apparently without exertion, can easily keep ahead of him

"Putting on the Brakes." With huge wings outspread, the returning parent checks its descent and alights on the nest. Flying at immense heights, the secretary bird looks much like a huge vulture with an elongated tail

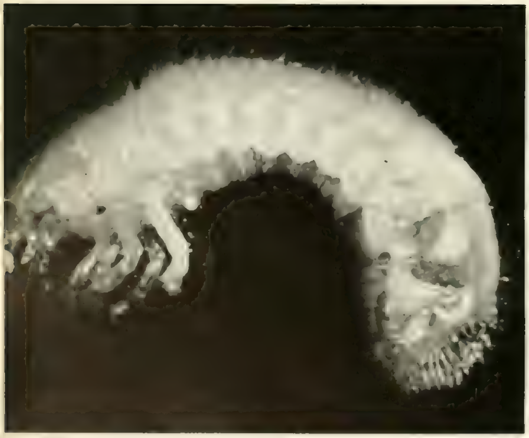
A tiny army fight

Against this formidable enemy of the garden, man cultivates a mighty ally in the form of a fragile wasp, which wages a curious warfare underground

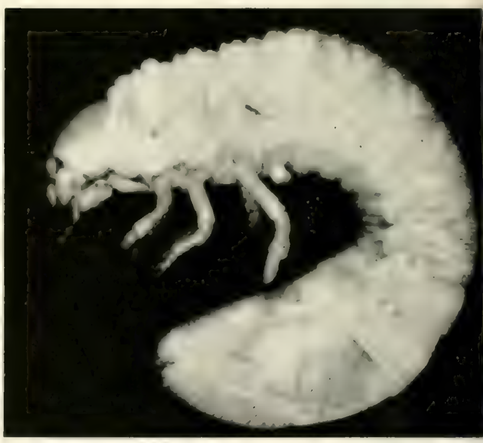


(Left) THE TINY DIGGER WASP *(Tiphia vernalis)* from Korea, which is a natural and deadly enemy of the Japanese beetle: a male specimen much enlarged. Four years of research in the Orient and experimentation with various other potential enemies of the Japanese beetle led to the establishment of this insect as one of the most successful insect allies in combating the pest.

The female wasps emerge from the ground in the spring when the weather gets warm, and burrow into the soil in search of Japanese beetle grubs, on which they fasten their eggs. When the larvae hatch they consume their hosts. Each fertilized female wasp lays in the neighborhood of 60 eggs



THIS is the grub of the unpopular Japanese beetle. The wasp's egg, the white oval object just back of the last pair of legs, is cemented to the body of the grub. The grub is actually about an inch long



AFTER about ten days the wasp larva hatches from the egg. The discarded egg case is seen here still adhering to the end of the larva's body. Though still scarcely larger than a pinhead, the enemy of the Japanese beetle will become almost as large as its host in the next twelve or eighteen days

he JAPANESE BEETLE

By JULIAN J. CHISOLM II

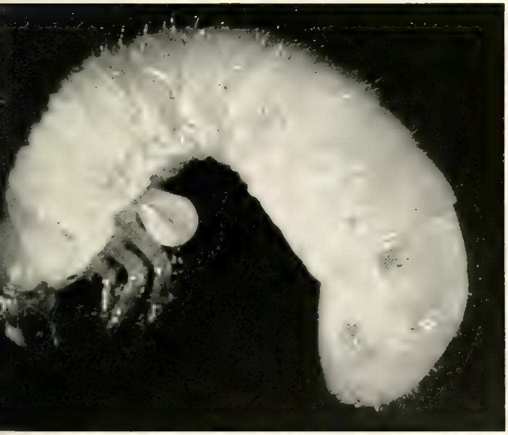
MOTHER NATURE has managed by various means to maintain a fairly even balance of life on the earth since time immemorial. When man steps in, either intentionally or accidentally, and upsets the balance in any region by the introduction of forms of life from other regions, trouble may result.

Many examples of this might be cited, but a specific case which is costing the people of this country millions of dollars is the accidental introduction of the Japanese Beetle *(Popillia japonica)*. For the first few years after its arrival from the Orient the enemy was apparently not noticed. Then in 1916, in the vicinity of Riverton, New Jersey, the infestation was discovered. Unfortunately, the Japanese beetle found conditions in this country entirely to its liking. As it did not have to contend with any of the natural enemies which Nature had provided to hold it in check in its homeland, it proceeded to reproduce in terrifying numbers and is now considered one of our serious insect pests.

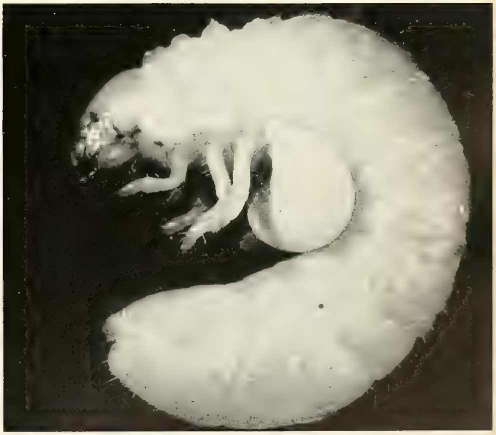
Shortly after it was obvious that this insect would become a major problem, and when normal procedures of insect control were found to be of no avail in combating it, the U. S. Department of Agriculture sent two of its outstanding entomologists to the Orient in 1920. They were to search for natural enemies of the beetle which could be established in this country and would eventually build up a population able to hold the pest in check, without becoming a menace themselves.

After four years of research and exploration in the Orient, a number of insect enemies of the beetle were found, and shipments of these were sent to the United States. Of these, five species became established, among which a certain wasp has so far proved to be the most important. The first shipment of cocoons of this wasp was made in 1924 to the U. S. Department of Agriculture laboratory at Moorestown, New Jersey. The cocoons were carried over the winter in the laboratories, and when the adults emerged in the spring, they were released in colonies in areas heavily infested with the beetles. Importations continued for about ten years, some in the form of cocoons but the majority as adult insects which were released as soon as they reached their destination. Since that time, colonies have become thoroughly established in this country, and these supply the material for propagation of additional colonies for release in other areas.

Tiphia vernalis, as this insect is known scientifically, is a little black wasp scarcely three-fourths of an inch in length, which lays its eggs *only* on the grubs of the Japanese beetle. It is related to the large



FEEDING on the grub's body juices, the larva of the wasp has grown during five days to the size shown above



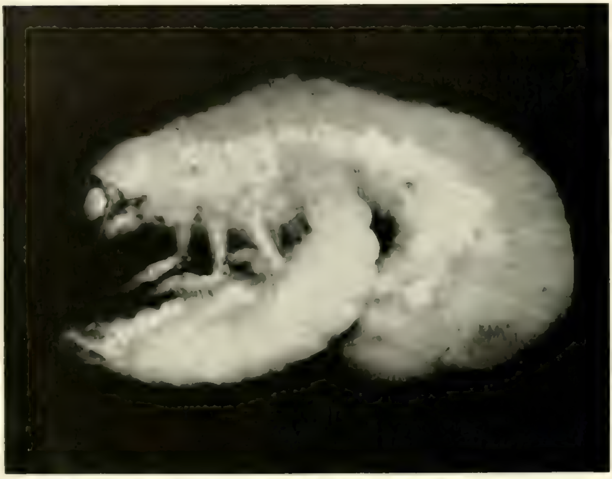
FIVE DAYS LATER the larva is nearing the mature stage, when growth is very rapid [illegible] species in the United States. These [illegible] to control the Japanese beetle.

The life cycle of the *Tiphia* [illegible]

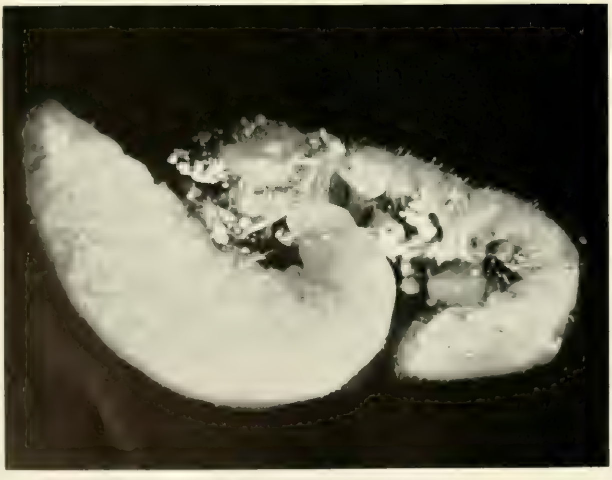
During May, generally [illegible] depending upon temperature and other seasonal conditions, the adults emerge from the cocoons in which they have overwintered underground. The insects mate, and the females, with no loss of time, start burrowing through the soil to find the grubs of the Japanese beetle, on which to lay their eggs. In this process the wasp [illegible] around the body of the Japanese beetle larva and with the tip of her abdomen mas[illegible] the last pair of legs. The egg is then deposited upon this massaged area and cemented in place.

Under ordinary field conditions each female para[illegible] during the period of oviposition, which generally lasts for a month to six weeks. During this active period, the adult wasps feed on the "honey dew" excrement of various species of plant lice, or aphids. Shortly after the last egg is deposited, the female dies, her life cycle completed.

In the meantime, let us go underground and see what is happening to an egg attached to one of the victims. In five to ten days, depending on the soil



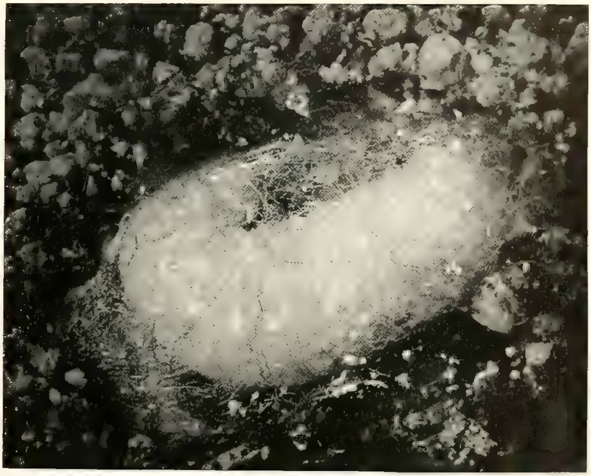
After five more days the larva is almost mature. The sucking habit of the young parasite larva has changed, and the further development of the mandibles enables it in this stage to consume the host, which is now dead



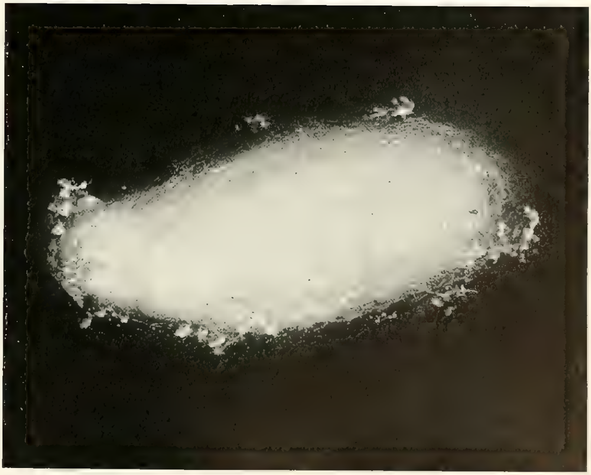
By noon of the next day: all that remains of the Japanese beetle grub. A few hours more and even this will disappear, and the larva will start to spin its cocoon temperature, the young wasp larva hatches and fastens itself securely to its host by inserting its mouth-parts through the skin tissues. The wasp larva at this time is not much larger than a head of a pin, but it has a voracious appetite and by greedily sucking the body juices of the grub, it grows rapidly. In twelve to eighteen days it is almost as large as its host. It is now nearly mature, and the remainder of its growth is very fast. During this period the mandibles become fully developed and are used in literally devouring the host grub, which is now dead as a result of the constant drain on its life fluids, sucked out during the early stages of parasitic growth.

In the course of the next twelve hours, the *Tiphia* larva spins a cocoon in which it subsequently pupates. After a short pupal period, it transforms to the adult and remains in the cocoon throughout the winter, emerging in May to repeat the cycle.

Here the question may arise as to what will prevent this insect from increasing in vast numbers and becoming a nuisance. The answer is this: the wasp population is dependent upon the beetle population, because without beetle grubs there can be no future generations of wasps. As the beetles are killed off, or at least killed down to what may be considered a normal population where their depredations would not be any greater than any other common garden insects, the wasp population will shrink in proportion.

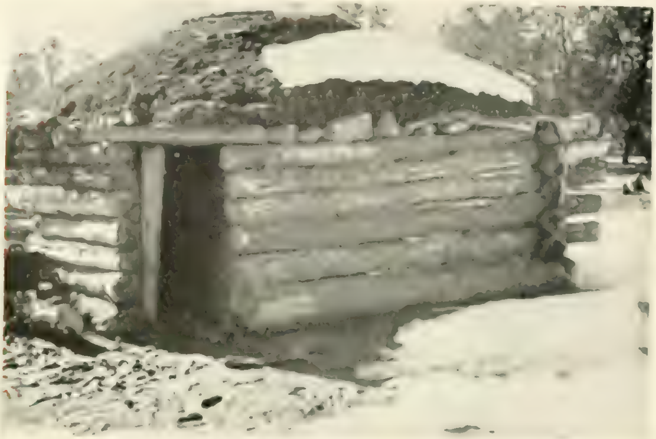


By evening the Japanese beetle grub has been consumed, and the larva which did away with it has started spinning its cocoon



The following morning the cocoon is complete. In this silken case the larva will subsequently pupate. The adult wasp then emerges from the pupa case but remains in the ground in the cocoon until the following spring, when it chews its way out, comes to the surface of the ground, and commences a new cycle in its warfare against the Japanese beetle

A NAVAHO BUILDS A HOUSE



A Story in Pictures

By

ALEXANDER
and DOROTHEA LEIGHTON

([illegible] [illegible] while under grant of the
[illegible] Science Research Council)

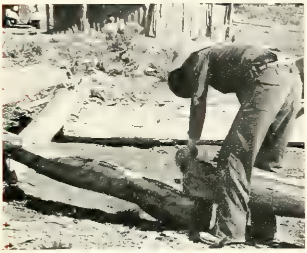
1 *(Below)* He wrests the raw materials

2 . . . from the semidesert,

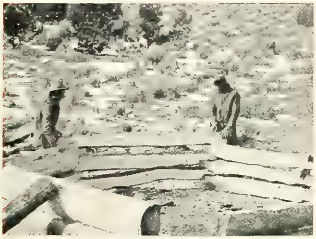
3 . . . and makes a row of notches first

4 . . . to square the logs. Assembling them,

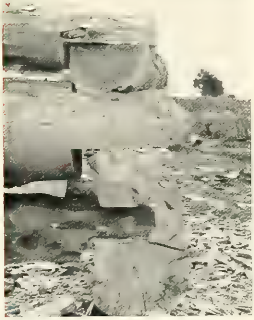
5 . . . he has an interested audience.



6 The walls begin to grow,

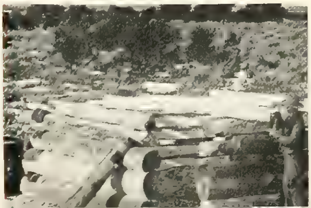


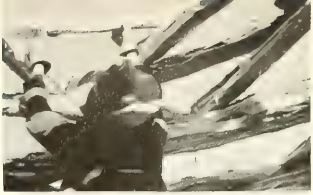
7 . . . as row after row is added,



8 . . . with nice joinery at the corners.

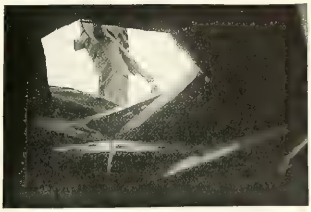
9 The roof starts shoulder-high



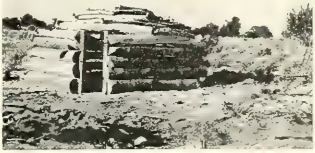


10 . . . and grows from the edges inward.

11 A youthful imitator studies Navaho architecture, as the smoke hole in the roof takes shape *(below)*

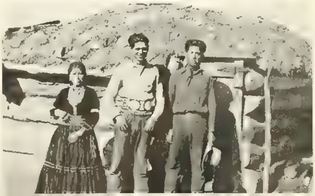


12 Now the house is finished



13 . . . except for chinking with mud

14 *(Below)* Ready for occupancy: the house and its builders

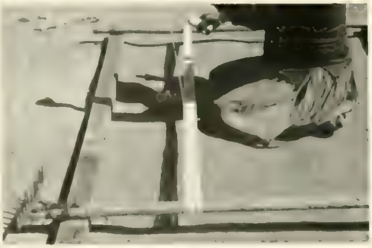


A NAVAHO MAKES A BLANKET

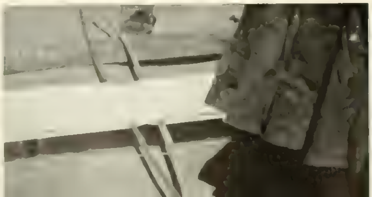
By ALEXANDER and DOROTHEA LEIGHTON

1 After clipping and washing, the wool is carded (*below*)

2 Any old frame serves to hold the warp (*below*)



3 . . . which is strung in a figure eight



4 (*Below*) The weaver binds the edge of the blanket with wool

5 . . . and goes to work at weaving,

6 pressing down the work with a batten

GEM FOR MAY

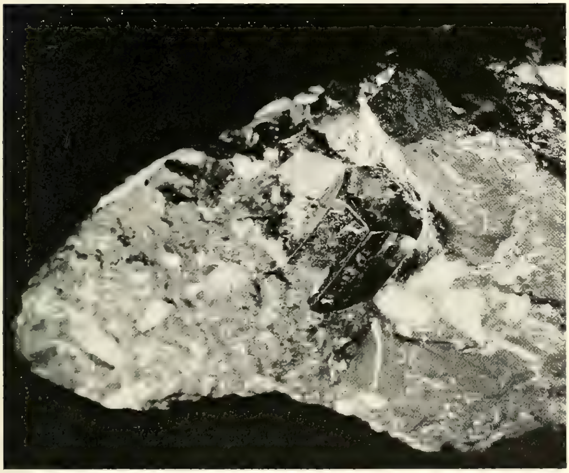
For those who gaze upon the rich green of the emerald, legend promises a panacea for eye trouble

By FREDERICK H. POUGH
Assistant Curator, Geology and Mineralogy, The American Museum of Natural History

UNTIL the Spanish conquest of America, the Old World had never seen a really fine emerald. For the finest examples of this most precious gem come from the mines of Colombia, which were known to the Incas but which thereafter were lost for many years, some even to this day. Even the Spaniards who first found these treasures in such abundance did not appreciate their rarity and worth. The story is told that the conquistadors applied the traditional gem test intended in reality only for the diamond: delivering a hammer blow to a stone on an anvil. It is easy to imagine what must have happened to many fine gems of this brittle and easily fractured mineral. However, the wiser priests are reported not to have tested *their* stones in this fashion. It is said, indeed, that they gathered the broken fragments of the stones discarded as worthless for their own loot. Eventually the true nature of the emerald was discovered, and the world demand for many years was filled from the Inca supply and later by Spanish operation of the mines. Many stones found their way as far as India to be carved and distributed as Indian emeralds.

A perfect six-sided emerald crystal from Colombia

Photo by the author



Emerald is a variety of the mineral beryl, a silicate of aluminum and beryllium. Beryl is the principal ore of beryllium, a light metal too expensive for use alone but of great value in alloys when combined with copper. We have already spoken of another variety of this mineral, aquamarine, but whereas the aquamarine is blue to blue-green, from slight impurities of iron, the emerald is a rich deep green, from chromium. Common beryl crystallizes in six-sided crystals, which sometimes attain tremendous size. Single crystals six feet in diameter and over 20 feet long have been found in Maine. But emerald crystals never approximate even an equivalent number of inches, for there appears to be an internal strain in emerald that results in many cracks and flaws, visible as the so-called "garden." This partial explanation of the small size of the crystals may also be the reason for the relatively greater fragility of the emerald in comparison with other beryl gems.

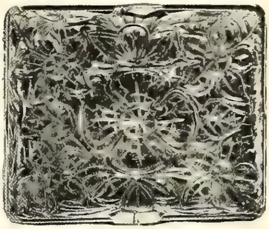
Emeralds are among the oldest of gems, and a mine in Egypt, which produces very low quality stones, is known as "Cleopatra's emerald mine." But apparently they were not abundant in those days either. Though we sometimes see strings of roughly polished six-sided prisms in museum collections, we more often see similarly shaped glass imitations.

Standards of color have changed through the ages, for, contrary to current taste, the ancients preferred light-colored stones. Emeralds were thought to sharpen the wits, to confer riches and, when placed under the tongue, to give the power of prediction; they were also thought to be of great therapeutic value, and formulas for the cure of poisoning by swallowing the powder of this gem were prescribed as late as the seventeenth century. The powers attributed to an emerald can probably be ascribed to the color—just as the powers attributed to the diamond stem from its hardness. Green is thought to be a restful hue, and many references to the use of an emerald to rest the eyes can be found. Gem engravers kept on their tables an emerald at which to gaze when their eyes became fatigued. Nero is said to have watched gladiatorial combats through an emerald, and in view of the superstition it seems quite probable that for once he was not merely indulging his prodigality but endeavoring to aid his eyesight. Water in which an emerald had stood was supposed to cure inflammation of the eyes.

In more recent times several new emerald localities have been found and old ones rediscovered, but even now none can compare with the Colombian deposits, which are still in operation. The gem crystals occur in a soft rock which is dug away in a series of terraces from which the stones are picked out by hand. Some are lost, washed away, or stolen, and the operation is seldom profitable. It is said that chickens, kept by the residents of the mine area, are allowed to wander around where the wash comes out of the mine, because fine stones which would otherwise have been lost are often found in their crops. Apparently, even the chicks have an eye for a good green pebble.

The Schettler emerald. Through probably mined in Colombia, its exquisite carving was done in India

AMNH photo by Kirshner



Deposits have been worked in Russia, where emeralds occur in the Urals with other gem stones; in Africa, where a few fine stones have been found; in the highest mountains of the Tyrol amid scenes of the greatest grandeur, though the stones are poor; and in North Carolina. Our American deposits have never yielded stones of good quality,—most of the crystals are small and are cut in rounded gems, with black and white associated minerals showing, and sold as emerald matrix.

But synthetic emeralds are for the scientist the most fascinating modern chapter of emerald history. Science has perfected a method (though not yet the stones) for the manufacture of this gem synthetically. Unlike the synthetic corundum gems, this compound actually crystallizes much as in nature, albeit in smaller and less perfect crystals. However, true emeralds, like natural pearls and true rubies, will maintain their worth even when man's imitations are made far better than they are today.

Thousands of tourists have watched this amazing ceremony, yet the secret of the Hopi priests, jealously guarded since prehistoric times, remained a matter of mystery and conjecture until an inquisitive snake expert captured one of the sacred rattlesnakes

The Hopi

By C. M. Bogert

[illegible]

THE HANDLING of venomous snakes publicly has been observed in several parts of the world. Cobras are "charmed" in India, China, and Burma chiefly as a spectacle or entertainment for which remuneration is expected from the audience. In Africa certain tribes utilize cobras and vipers as well as harmless snakes in ceremonies, the exact significance of which seems not to be well known. Perhaps no more spectacular, but certainly the best known of ceremonies in which snakes are used, however, is the Snake Dance of the Hopi Indians of northern Arizona.

Sixty years ago the first account of the Dance was published, and subsequently literally hundreds of accounts have appeared in newspapers and magazines, or even woven into novels. The details of the ritual have been rather thoroughly studied by ethnologists, who have prepared detailed reports. Only one phase of the Dance remained unexplained,—the ability of the Hopi Indians to handle rattlesnakes without any apparent ill effects. There has been speculation in abundance; every conceivable opinion and many ludicrous ones have been offered. Still the matter has remained largely one of conjecture and opinion.

Therefore, when an occasion arose for me to attend the snake ceremony, I looked upon it as an opportunity to try to settle the question. The dance had been seen by a competent herpetologist, Mr. L. M. Klauber, whose specialty is rattlesnakes. His excellent report* summarized the important and pertinent information that had been printed during more than half a century, and his conclusions were based upon a consideration of all facts available. Still there was something to be desired. No rattlesnake actually used by the Indians in their dance had been secured for examination since 1885 when Yarrow, an early investigator, examined two snakes that were "captured" after the dance; and there was no certainty that his snakes were ones that had actually been used in the final part of the ceremony, where live rattlers are carried suspended from the mouth.

Mr. Klauber had concluded that snakes used in the dance most probably had had their venom extracted, but he had reason to believe that the fangs were intact. Planning my course of procedure from the very complete summary Mr. Klauber had made, I hoped therefore to secure a rattler that I knew had been used in the snake ceremony.

I did not anticipate that this would be a simple

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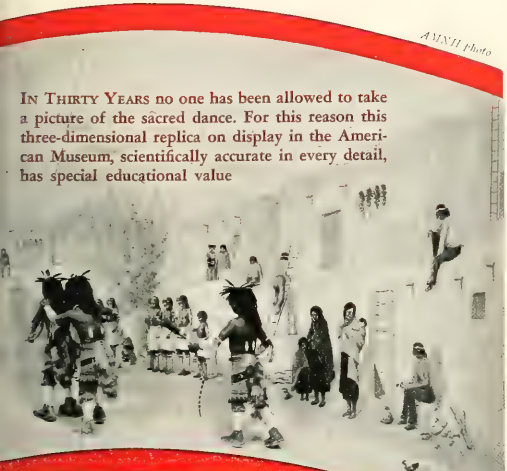
*[illegible]


AMNH photo

In Thirty Years no one has been allowed to take a picture of the sacred dance. For this reason this three-dimensional replica on display in the American Museum, scientifically accurate in every detail, has special educational value

AMNH photo by Bierwert

task. I was acquainted with the Hopi Indians and their villages, located on the three fingers of a mesa that extend southward into the Painted Desert. I was on good terms with several Hopis, and I knew them as a friendly, intelligent, and industrious tribe of Indians. I knew that their Snake Dance was part of a religious ritual, and as such I had no desire to meddle with anything that would offend their sense of privacy. But I did want to obtain a rattlesnake used in the dance.

Some rationalization was necessary. After all I was a collector. Perhaps after the ceremony was finished it might be possible for me to obtain a specimen just as I might have captured any other in the course of the day's field work. I knew that the snakes were liberated as soon as the ceremony was over, and the capture of one of the rattlers that had gone through the ceremony seemed at least feasible. Therefore, I held this notion in the back of my mind when Mr. Glover Ruckstel of the Grand Canyon Airlines proposed a trip by plane to the Snake Dance. It was a mere half-hour's flight to the Hopi villages over an interesting terrain that I knew from below but had not seen from the air. Even if my plan did not work out as I hoped, I knew the trip would be interesting.

Every August there are Snake Dances on successive days during the even-numbered years at Shipaulovi, Shongopovi, and Hotevilla. A small dance at Shipaulovi had taken place the day before we arrived, and the afternoon of our arrival we saw the second dance at Shongopovi. The next day the largest ceremony of the three was to follow at Hotevilla.

What we see as the Hopi Snake Dance is in reality only the culminating rite of a nine-day ceremony conducted by two fraternities known as the Antelope and Snake Societies. The late Dr. J. W. Fewkes called it, "A serious, precise religious rite which has survived from prehistoric times to our present day. . . . No Hopi priest lives who understands the meaning of all the details, nor does he care for an explanation of them. There are two fundamental factors, however, which he can comprehend, and these are always on his lips when an explanation is solicited, 'We cling to the rites of our ancestors because they have been pronounced good by those who know. We erect our altars, sing our traditional songs and celebrate our sacred dances for rain that our corn may grow and yield abundant harvest.' "

Contrary to first accounts published in 1881 and 1883 and to later popular, impressionistic, and often inaccurate accounts, the rite is not snake-worship. Rather, the serpents, gathered from the fields, are looked upon as messengers intrusted with the prayers of the people, and after the dance they are liberated to " . . . bear these petitions to the divinities who can bring the blessings of copious rains to the parched and arid farms of the Hopi."

The Hopis have other equally important ceremonies, but owing to the use of reptiles in the public part of the Snake Dance, it has become one of the most widely known religious rites practiced by a primitive people. The liquid consumed by the priests [illegible] the liquid had been supposed to serve as [illegible] [illegible]." But it is [illegible] that it should not be called an antidote, for the Indians themselves do not claim any physiological action for it. Mindeleff pointed out this fact in 1880. The Indians prefer to consider the action one of witchcraft: it is not the liquid itself but the chants and ceremonies whereby it is consecrated that render it effective. Many arguments have been waged over the methods by which the Indians handle the venomous snakes without serious consequences; what we wanted to find out was whether they defang the snakes or not.

Four days of the nine-day ceremonial are devoted in part to snake hunts in the four cardinal directions—north, west, south, and east, always in the order given. Other days are given over to the consecration of *kivas*, or underground ceremonial chambers, to the making of a charm liquid by the Antelope priests, and the making of *pahos*, or prayer sticks (usually sticks to which are fastened eagle feathers, cornhusks, packets of sacred corn meal, etc.). All of this is accompanied by the singing of traditional songs, many of which contain words foreign to the present-day Hopi language.

Besides these secret rites there is a public "Antelope Race," a "Corn Dance," a "Snake Race," and lastly, the "Snake Dance," followed by the taking of the ceremonial emetic. Feasting and merrymaking close the celebration.

Sacred

Despite their poorness in worldly goods the Indians have resisted all attempts of the white man to commercialize their ceremonies. Considerable sums of money reputedly offered for movie rights have been refused, and for the last 30 years no cameras have been allowed on the mesa while the dance was in progress. Unfortunately, some present-day visitors are inclined to look upon the ceremony as a sort of vaudeville show. Yet the dance is part of a religious ceremony, and how annoyed we should be were a group of Indians to attend one of our churches with the same spirit!

When we arrived on the top of the mesa, we left our cars on the outskirts of the village and wandered in toward the plaza. Although it was still early, crowds were beginning to gather. Even a few Supai Indians had ridden all the way from the west end of Grand Canyon, nearly 150 miles, to see the ceremony. Navahos on horseback were arriving in small groups, others were in wagons that clattered and squeaked as the horses toiled up the narrow road to the mesa top. Once the enemies of the Hopi, the Navaho Indians have been forced by the white man's rule into comradeship, although a present-day saying of the Hopi, "Food draws flies and Navahos," is indicative of the Hopi's feeling of superiority.

We continued toward the plaza, hoping to get in a good position, for I wanted if possible to obtain data on the kinds of snakes used. Already the plaza was lined with people. At one end was a conical bower of cottonwood boughs with a white cloth over the entrance, the *kisi*, where the snakes were to be deposited in bags prior to the dance.

The housetops and windows surrounding the plaza were filled. Several Hopis came through carrying a long forked log. A commotion on a housetop revealed that this wood was being rushed to reinforce the bracing where a roof was sagging from the weight of 40 or 50 Indians in the "grandstand."

At least 700 people had gathered, 50 to 75 per cent of whom were Indians, and color was rampant. There were Indians in all possible as well as some impossible garbs. An old, gray-haired Hopi sat in a dignified manner on a doorstep, wearing for headgear an old-fashioned, blue, broad-brimmed, lady's straw hat decorated with varicolored grapes and artificial flowers.

Navahos meeting friends gravely shook hands, spoke a few words and remained silent, waiting. A tourist offered an Indian a cigarette. The Navaho took two, put one in his mouth and the other in his shirt and held out his hand for a match. Many other Indians approached and quietly and with dignity received their quota of cigarettes. The tourist looked disgusted, then smiled and handed the package to the Navaho, who grinned knowingly. The Navahos inhaled deeply and contentedly expelled streams of smoke from their nostrils.

There were several dude ranchers in blue jeans, cowboy hats, high-heeled boots, and large silver-concho belts—New Yorkers, Californians, and Missourians "gone western." There were Harvey bus drivers in brown riding breeches, bright-colored shirts, and neckerchiefs, and Arizonans from the closer towns, Holbrook, Williams, and Flagstaff. A middle-aged Indian woman, with yellow hair and white skin, attracted only slight attention as she walked through the crowd, perhaps because she was not recognized by most of the white people as an albino Indian.

The snake dance begins

Navaho and Hopi policemen moved about the plaza, mildly urging people to take places near the walls and those in the front row to sit down. They cleared an opening in the corner to the right of the *kisi*, and the audience gradually settled and became quiet.

There was a hush. Into one corner of the plaza came the Antelopes led by the Antelope Chief, who carried the *tiponi* or badge of office which for the last eight days had hung on the ladder leading into the Antelope *Kiva*. Fantastically costumed and painted, they marched into the plaza, fourteen of them, including two youngsters, neophytes, bringing up the rear. Four times they made a circuit of the plaza passing before the *kisi,* where each stamped violently with his right foot on a board covering a hole, the *sipapu,* symbolic of the entrance to the underworld.

After the fourth time around they lined up facing away from the covered entrance to the *kisi* and started their chant, shaking white rawhide rattles held in each hand.

The Snake Priests entered, sixteen of them, walking rapidly with a determined, more impetuous gait than that of the Antelopes. Four times they proceeded around the plaza led by their chief, an old, gray-haired, stocky, broadly-proportioned priest. Like the Antelopes, they stamped upon the board covering the *sipapu* and then lined up facing the other Society.

Following this, the Snake Priests, with their arms extended below their hips, clasped hands and leaned forward, swaying to a low chant, which was alternated with a shaking of the rattles by the Antelopes who remained erect. This continued for several minutes. The Antelopes then stepped back, seven men in line on each side of the bower of cottonwood boughs. One Snake Priest got down on his knees, lifted up a corner of the cloth over the entrance to the *kisi,* and crawled inside.

The snakes are produced

The other members of the Society divided into threes, one of each trio moving out into the plaza, the remaining ones, in pairs, lining up to the right of the *kisi.* A priest on his knees pushed his head and shoulders under the cloth and came out with a fair-sized serpent. It was a snake belonging to a stunted race of the prairie rattlesnake, now named *nuntius* or "messenger" in allusion to its use in the Hopi Dance. The priest rose to his feet and placed the snake in his mouth, grasping it in his lips and teeth a third of the way back from the head. His comrade, the "hugger," placed a hand on his shoulder, and together they began a shuffling dance around the plaza. The rattler, its tail hanging sinuously, moved its head from side to side as the "carrier" danced. From time to time the hugger reached in with a two-shafted feather wand, the "snake whip," and gently brushed the reptile's head away from the carrier's face.

Followed by the hugger, the carrier of each of the five pairs was now dancing about the plaza, with a snake held in his mouth and supported by the hands. Three or four times they passed the *kisi,* and then one snake was placed upon the ground, its head directed away from the *kisi.* Thereupon it started to crawl—toward the audience. There was some confusion, and people in the vicinity prepared to move back. Other snakes were soon placed upon the ground; one was an exceptionally large bull snake. A rattler coiled but was brushed with a wand by one of the men not dancing, a "gatherer," who picked up the snake by the middle as it started to crawl off.

Snakes were being received at the *kisi,* others were being carried, several were on the ground being watched by the gatherers, all in more or less confusion. Unnoticed by the Snake Priests, a large rattler crawled toward a woman in the front row. She shrieked and threw her purse at it. The audience was noisy—some people were laughing, but the general feeling seemed to be one of nervous excitement.

I kept count of the snakes in my notebook as each snake was received from the *kisi.* Finally there seemed to be no more rattlers, and all the dancers were carrying long, yellowish-blotched, bull snakes. One snake, different from all others, came out of the *kisi* in the mouth of a dancer. It seemed to be a western glossy snake *(Arizona elegans),* a species not previously recorded in the dance. There were apparently no more snakes in the *kisi,* and I glanced at my notebook. I had a record of ten prairie rattlers, three Great Basin racers, nine Arizona bull snakes, and the one glossy snake. The gatherers were each holding three or four snakes, and some of the Antelope Priests had a few.

The snakes are freed

The last snake was finally picked up at the *kisi.* A priest drew a ring with sacred corn meal on the ground, sifting the meal dexterously through his fingers. The Antelope Priests, who until now had been holding the serpents, placed them in the center of this circle, a writhing mass of sinuous, shining bodies. Some Hopi women came forward from the crowd and sprinkled more sacred meal on the snakes. Suddenly there was a quick movement, and the Snake Priests hastily seized as many snakes as they could. They dashed out of the plaza and down off the mesa in the four directions, to snake shrines where the serpents bearing their messages were to be liberated in the rocks.

We watched the dancers as they fled from the summit of the mesa. It was after sundown and the surrounding desert was a glorious sight. A few cottony clouds still caught the sunlight, but within another hour we knew that it would be too dark to attempt to find the snakes after they had been liberated. Nevertheless, haste was impossible, and we wandered

(Left) AN AIRPLANE brought the travelers from the Grand Canyon to see the Snake Dance. Uppermost in everyone's mind is the question of how the priests can hold the venomous rattlers in their mouths with impunity. The author of the accompanying article lingered after the rest of the audience had left and found a surprising answer

(Below) WARY of their age-old enemy, the Navaho, the Hopis built their villages on mesa tops long before the coming of the white man

(Below) THE ANTELOPE PRIESTS in full ceremonial regalia, preparing to enter the plaza for the Dance

(Below) THE SNAKE PRIESTS enter, with the Antelope Priests already in line before the cottonwood bower or [illegible]

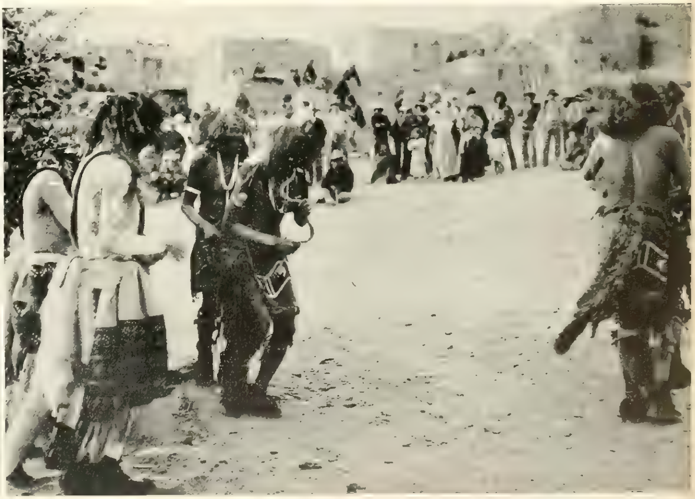
(Right) Meat is hung out to dry in front of this Hopi dwelling, in keeping with ancient custom. These red men are among the few tribes who have resisted white culture with any degree of success. Reputedly they have turned down several Hollywood offers for film rights to their ceremony

The Ladder *(left, below)* leads to one of the underground ceremonial chambers or *kivas,* where secret rites of the Snake Ceremony precede the Dance

Typical three-story Hopi houses are shown below

Photos by H. C. James

kisi where the snakes have been placed prior to the Dance. The 41-year-old photograph at *lower right* shows a priest with a rattlesnake in his mouth. In the other pair of dancers the "hugger" conceals the man with the snake



[illegible] three Snake Priests, who were still running with [illegible] their movements even after they were three or four hundred yards from the foot of the mesa. I saw them head for a group of sandstone rocks larger than others in the vicinity, and soon it became apparent that these were to serve as the shrine where their messengers were to be liberated.

The priests spent a few minutes at the shrine, and though I could barely make out their movements through my telescope, I suspected from what I could see that they were placing the snakes in crevices in the rocks. When they had finished their task and turned toward the mesa, my companion and I climbed down the rocks at the edge of the mesa to follow the same trail that the priests had taken, and we headed down the slope. Other people, both Indians and whites, were leaving the mesa by the same route, and we moved along no faster than they. In a few minutes, we met the returning priests, dogtrotting up the hill and they passed without glancing at us, panting and perspiring. Both Hopi and Navaho Indians were scattered about the foot of the mesa, some of them harnessing their horses to wagons or saddling their mounts, while others were already setting out across the desert.

To avoid discovery

Hastily considering the situation, we concluded that it might be better if we did not go directly to the shrine, which was about a hundred yards to the left of the best-traveled wagon road leading from the village. Instead, it seemed more prudent to take a circuitous route, following the road for only a few hundred yards and then swinging over to the left and cutting back to the patch of rocks where we knew the snakes had been left. In doing this we encountered several small gullies, and after we had walked far enough away from the road and turned again toward the mesa, we emerged from one of these gullies to find ourselves a trifle confused. Where we had seen only the one conspicuous group of rocks, there now were several that seemed equally prominent. Nevertheless, we worked our way toward the village, and at last got our bearings well enough to be reasonably certain that we were approaching the shrine.

When we reached the rocks, however, we could find nothing. We moved about among the huge blocks of the sandstone outcrop, scrutinizing everything carefully, until at last we came upon a *paho* or prayer stick thrust into the ground and, like other paraphernalia used in the dance, sprinkled with sacred meal.

Now, at least, we knew we were in the vicinity of the liberated snakes. Still we saw no sign of them and at this juncture we looked up to see a Hopi staring at us intently from a distance of 30 or 40 feet. Abruptly we lost interest in snakes, and our attention was as suddenly drawn to the scraps of pottery that lay strewn about the ground here as elsewhere in the adjacent desert. The Hopi continued to watch us as we moved away from the shrine, continuing our interest in ceramics, but he seemingly concluded that we were harmless gatherers of souvenirs and went on his way.

Waiting until he was well out of sight, we again wandered back to the place where the *paho* was thrust into the ground. This time I chanced to glance upward from the ground, to which I had previously confined my scrutiny. There in a narrow crevice was a snake, its head downward and its coils drawn together so that it held itself in the crack some four feet from the base of the rock. Observing that it was a bull snake, I seized it by the tail and withdrew it. Immediately below in the crevice I could now see the coils of a second snake, obviously the snake that I sought, since the rattles on its tail were clearly visible. Hastily I liberated the bull snake, and drew forth a stout denim sack that I had carried in my pocket. With little trouble, I seized the tail and extricated the rattler from the crevice. Using a stick that we had selected on our way over to the shrine, I held the snake's head against the rock and obtained a safe grip on its neck. My companion held the sack open, and I gently dropped the snake into it, tying the sack securely with the string attached to it.

Fortunately the rattler was not a large one, not more than 30 inches in length, and it was no great bulk to carry. Nevertheless, I felt a trifle uneasy carrying the sack, knowing that Indians inevitably would be encountered. I had no desire to have them know that I had collected one of their messengers. I felt certain that the Indians, as well as I, would be happier if they did not see me with it. As a matter of fact, I seriously doubt whether any of them would have guessed what was in the sack, but in my feeling of guilt I decided that it was best to carry it where it could not be seen.

Snake in the hat

Therefore, I rolled the length of the sack around the rattlesnake and stuffed it into the crown of my hat. The hat no longer fit very snugly on my head, but it was possible to carry the snake there, and with a feeling of satisfaction, we turned to retrace our steps, away from the mesa and the shrine.

When we had reached the sanctum of a deep gully, the thought occurred to us that it might be wise to examine the snake immediately, just in case anything were to happen later that might make this impossible. Therefore, we removed the snake from the sack, and again obtaining a grasp on its neck, we induced it by use of a pencil to open its mouth. A hasty examination showed *no fangs to be present*. Even when the point of the pencil was pushed under the fang sheath, no fangs could be demonstrated. Satisfied with this hasty examination, we returned the snake to the hat and in the dusk hastened back to camp.

Conditions that arose the next day made it impossible for me to return to the city for several days. The rattler was examined from time to time, and it seemed to be in a good state of health, active but not so inclined to strike as a normal rattlesnake would have been. Two weeks after its use in the dance, the snake, still alive, was forwarded to Mr. Klauber in order that he might examine it in as nearly as possible the same condition as when used in the Snake Ceremony. In response to my request he killed the snake and preserved it. As an alcoholic specimen it was more thoroughly examined, and an amazing discovery was brought to light. Not only were the functional fangs removed, but the embryo fangs as well had been skillfully cut from the jaw so that the snake was made permanently and completely safe to handle. The venom glands were still intact, but without fangs the danger of any venom being injected into one was almost nil. Such a snake would inevitably die, since venomous snakes possess fangs primarily for the purpose of securing their prey. A rattlesnake without fangs would be as helpless as a chicken without a beak, since it is not a constrictor and, therefore, could not kill rodents upon which it normally feeds.

An amazing skill

It remains an astonishing fact that the Hopi Indians are sufficiently well acquainted with the anatomy of the rattlesnake to remove so skillfully the reserve fangs. Few people, even among those who habitually handle rattlesnakes in circuses or in carnival shows, are aware of the fact that all venomous snakes periodically shed their fangs and that merely breaking off the functional fangs does not render the serpents permanently harmless. This ability of the snakes to grow new fangs has been voiced as a logical objection to the theory held by some (who claim to have been told by the Hopi priests themselves) that the rattlers merely had their fangs torn out at the time of capture.

So we may give these Indians credit for having considerable practical knowledge, knowledge perhaps gained by an observing Hopi several centuries ago. Anyone might readily observe the series of replacement fangs if he examined the skeletal remains of a rattlesnake carefully enough. But few people pause to make careful observations, or to interpret them correctly, and, for that matter, it is only within the last decade that the scientific literature dealing with the mechanisms of fang succession has given a very clear, or even a moderately complete, picture of the process.

Native methods elsewhere

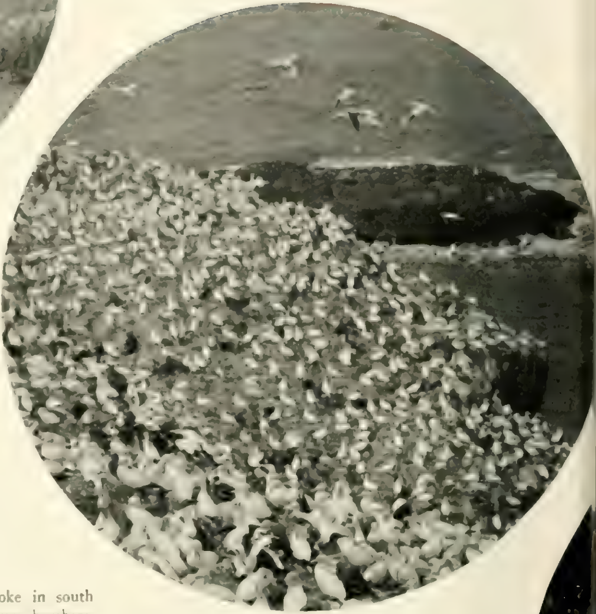
On the other hand, much of the fundamental knowledge of the venom apparatus of snakes seems to have been utilized by peoples in other continents as well. Recently, while studying the fangs of Asiatic cobras, I found that snakes purchased from Hindu fakirs had been as completely defanged as the rattler taken at Shongopovi, whereas those secured in the field by the museum's collectors all contained the normal complement of fangs.

At Harvard's Museum of Comparative Zoology, through the interest of Mr. Arthur Loveridge, I have also had the privilege of examining an African night adder, the donor of which stated that, after undergoing "immunization" as practiced by one of the African snake cults, he had been bitten by it without ill effects. This snake likewise proved to be completely devoid of fangs. While I have no doubt that the man who returned with the viper that bit him sincerely believed that he was immune to snake venom, his "immunity" was as much a myth as the ability of the Hindu to "charm" his cobras.

There is but one completely safe method of handling venomous snakes. This consists in putting out of commission some essential part of the venom apparatus. It is possible to do this in several ways. The mouth may be sewed closed, and the stitches carefully concealed, thus preventing the snake from biting. This method has been reported in Africa and Asia. The removal or destruction of the venom glands or portions of the venom ducts has been accomplished on living snakes, but the procedure is difficult, and there are no authenticated reports of primitive peoples utilizing this method. Finally, the simplest way to make it practically impossible for a venomous snake to defend itself consists in removing all of the fangs, and quite probably this is the method most commonly employed. At least we know that the Hopi, the African native, and the Hindu skillfully employ this technique.

ENGLAND

By Winifred Comstock Bowman



(Above) Grassholm Island and its "gannetry" seen from the ocean. When approached by humans, the great white mass of screaming, fluttering birds add squawks of terror and indignation to the general bedlam. Twelve miles off the Welsh coast, this tiny speck of land is within earshot of the bombing raids on Pembroke. *(At right)* A close-up of this well-populated sanctuary

[illegible] Bowman

For many months now, Pembroke in south Wales has been a target for German bombers. In this new existence of mine, exiled by the war from a country where I have lived for fifteen years, place names and the memories they evoke are my one reality. So it is that the mention of Pembroke and Milford Haven in the German communiqués brings back vividly and persistently to my mind a holiday my husband and I spent on the little island of Skokholm in 1937. It is difficult now to realize that the tiny peaceful island lies near enough to the English naval base to have its quiet shattered by the roar of the German bombers as they swoop toward their objective a few miles distant; and that the thunder of bursting bombs sends the colonies of puffins and shearwaters wheeling into the air with answering cries. For Skokholm is a bird sanctuary.

One night in 1937 my husband and I saw a film called *The Gannets,* with a commentary by Julian Huxley. It was a study of the island of Grassholm off the coast of south Wales, an island which is inhabited solely by a huge colony of the great sea birds called gannets. This film was beautiful and interesting and made a great impression on us. My husband has always been interested in birds and their ways, and eventually he suggested that we, too, visit the island, and perhaps take some films of our own. We had recently acquired a small movie camera, and since color films had just then become fashionable, we would take our films in color.

I must say here, that in common with most Americans, I knew very little about birds—and, unlike most Americans, nothing at all about color filming. But I like out-of-the-way places, new activities, and acquiring additional bits of knowledge. So I fell in with the plan at once.

At first we were puzzled as to how to reach Grassholm. On the map it is a tiny dot about twelve miles from the nearest coast line, and we knew no one lived on it and that it was not a place where we could stay. We would have to make our headquarters elsewhere, probably on the mainland, and find our way to Grassholm by boat.

The nearest village we could see on the map was Dale, and accordingly my husband wrote to the vil-

IS AN ISLAND TOO

Unequalled in their love of winged creatures, the English have established many sanctuaries for birds of land and shore. Here is the record of a pre-war visit to one of the offshore islands now disrupted by Nazi bombs

lage clerk there, asking him for information about accommodations, and permission to visit Grassholm. Several days later an answer came; not from the village dignitary, but from R. M. Lockley of Skokholm Island.

We knew nothing of Lockley then but were delighted to find that his bird sanctuary on Skokholm, about six miles from the coast, was open to bird-enthusiasts at a fee of nine shillings a day, including bed and board and a "reasonable amount" of cider. A lobster boat would take us to and from the island for a fee of six shillings. The little booklet in which these details were set forth was obviously designed to discourage all but the most genuine of bird lovers. It pointed out that living conditions on the island were very primitive, that everyone was expected to make his own bed, do his own room; that the men slept in a dormitory separate from the wo-

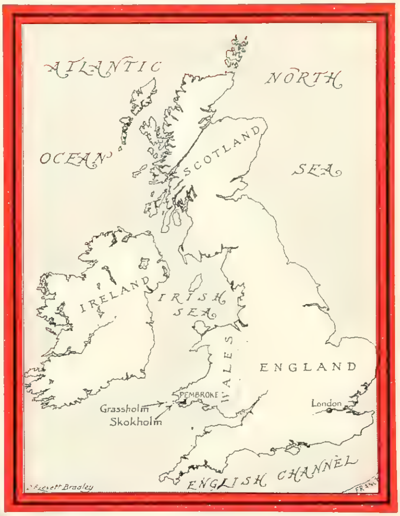


Photo by
R. M. Lockley

(Left) **Feeding** by regurgitation *(foreground)* has its drawbacks—for human visitors. The youngsters are often finicky and leave portions of their daily fare exposed to the strong sunlight. Some 40,000 birds occupy this island

[illegible] that the women were expected to help in the [illegible] It was a [illegible] condition that visitors to the island were expected to assist in the drives which [illegible] place the [illegible] ready to round up and band the migratory birds.

[illegible] I said to my husband. "I don't [illegible] I ought to go. I don't mind a primitive life or taking my turn in the kitchen, but it's obvious that I don't know anything about birds, and you can see this Lockley person means business. I'm likely to be turned off the island the first day."

"Nonsense," said my husband, "he won't expect both of us to be equally knowledgeable about birds. You need only show a little interest and help me with the filming."

I looked at him. After nine years of marriage to an Englishman I had never quite got used to the role of subordinate. Suddenly this holiday took on a sinister aspect. So I could show a little interest and help with the filming (that meant carrying the rolls of films around and being sworn at when I misplaced one) and thus be tolerated on an island where clearly I was not wanted!

"No," I said, "I'm not going to pretend anything. I'm going to take my typewriter and work on my play, and if you or he doesn't like it, that's too bad. I can't possibly count birds, my eyes are too bad to see anything more than a few yards away, and anyway I don't know one bird from another."

"You can learn," said my husband, quietly and firmly.

The road to adventure

We started for Wales one morning at the end of July. We felt very gay and grand. The day before we had traded in our old car for a second-hand Ford with a very special body with low, raking lines and elegant leather upholstery. We were very proud of this car, and in honor of it I wore a new pale blue tweed suit, a smart sports hat, and lots of nail polish. Even my husband, who prefers gray flannels and old tweed coats had put on his new brown suit, so as not to disgrace our ultra-smart vehicle. Oh yes, we were a sophisticated young couple speeding down the long roads of England into Wales. I giggled when I thought of the primitive island. I'd show this Mr. Lockley!

Pembrokeshire is quite different from the rest of Wales. Indeed, the small part of it around Haverfordwest and Dale is called "little England," and the rest of the country consider the people who live there as foreigners. Dale is a tiny seaside village at the end of what is really a country lane. The Welsh, even in this English corner, are suspicious of strangers, and the landlady of the pub replied firmly to [illegible] request for a room and bed that she had no a[illegible] and didn't know where we could get any. People around here didn't like taking anyone in for one night, it wasn't profitable.

This reception was a bit discouraging. We sat in the car while dusk fell, debating what to do. We could sleep in the car, but that wasn't an alluring prospect after having spent most of the day in it already. We could make the rounds of the scattered cottages and farms to ask for a bed, but our petrol was low, and there didn't seem to be any way of getting more in the village. We must save enough to get back to Haverfordwest on our return journey. While we were sitting there a man turned into the little square and stood looking at us for a moment. He was of medium height, dark-haired, stocky, clad in brown corduroy shorts and jacket. Presently he came over to us.

"Are you Doctor Bowman?" he asked my husband.

"I am—are you Lockley?"

"Yes." He looked at me rather hostilely, I thought. I was conscious of my new suit and my lipstick.

"Good," said my husband. "This is my wife."

"How do you do." Lockley held out a big, sunburned hand. I shook hands with him. He noticed the red fingernails.

"I'm afraid you'll find the island rather primitive," he said coldly.

"I shan't mind a bit," I said, "I like roughing it."

"Oh!" He was clearly skeptical. I smiled inwardly. It amused me to pose as the sophisticated nitwit before this man of nature. I knew perfectly well my own capabilities, and was looking forward to his "primitive existence." But I was aware that bird lovers, in England at any rate, are not accustomed to use make-up and drive about in rakish cars. I must have been a shock to him, and because of his obvious uncertainty about me, I was prepared to dislike him. I suspected him of being an autocrat on his island.

But where to spend the night?

My husband was explaining our predicament about sleeping quarters.

"You should have asked me to arrange things for you," Lockley said impatiently.

"I didn't like to trouble you," said my husband. "But don't worry about us. We'll manage to find some place."

"I'll ask the schoolmaster to take you in," Lockley said. "He lives up the hill, behind the village."

"No, no—please don't trouble. We'll look for a place."

"I'll ask him," repeated Lockley, "and meet you here in half an hour." He walked away into the gathering darkness. We looked at each other.

"A bit difficult," said my husband.

"He thinks I'm a fast woman, and totally useless," I said, grinning. "Nothing could keep me off that island now."

We got back into the car and started off to make inquiries about the night. But we had no luck. Finally we went into the pub to ask if we could have a meal. The landlady looked bored and reluctant.

"I don't serve dinners," she announced grimly.

"Something cold, perhaps?" I asked timidly.

"We-ell, there's a bit of ham and some tomatoes—"

"I'd like some ham and eggs," said my husband firmly.

"And some tea," I added, taking the cue.

"It will be a few minutes—there's the kettle to set boiling."

"Oh that's all right," we said. "We don't mind waiting!"

In the end we had a meal that was eatable if nothing else, and in the midst of it the landlady suddenly melted and said she could give us a bed, though it would mean that she and her husband would have to move out and sleep elsewhere. We had nearly finished our meal and had made our arrangements with the landlady about our sleeping accommodations when Lockley strode into the room with the news that he had arranged with the schoolmaster for us to sleep there.

Too many reservations

This was bad. We dared not turn down the landlady's offer after she had made such great concessions on our behalf. On the other hand we could see that Lockley was annoyed that we had not waited to consult him. In the end my husband went with him to the schoolmaster's and explained the situation to him. But we were a bit uneasy.

"I don't think I'm going to take to Mr. Lockley," I said, as we undressed, "or he to me."

"He's all right," said my husband, "he's got character. Also he's not quite at ease with us—we don't conform to type."

"He should be able to judge human beings better than that."

"Why?" said my husband, "he's a judge of birds, not of men."

"People shouldn't narrow their interests. The proper study of mankind—"

"Go to sleep," said my husband. "We have to be up at five-thirty to catch the tide."

"Tides," I thought. "Why do they always have to do their work at such an ungodly hour?" But I was glad enough to get up at five and leave our unpleasant bed and stuffy room.

Ready for the primitive life

I dressed this morning in slacks and a dark blouse, but I was deliberately liberal with lipstick and nail polish. Not for any Lockley would I concede that the primitive life excluded beautifying effects. My husband, however, now looked the part, and I could see Lockley was relieved at the sight of the ancient gray flannels and the worn Harris tweed jacket. The morning air was cold, and I donned a sweat shirt and mackintosh before we went down the beach to the boat. Here I was once more in disgrace, for the boat lay several yards out in the water and the only way of reaching it was to wade. Neither of us had brought boots, so my husband took off his shoes and socks, rolled up his trousers, and staggered with me in his arms through the icy water to the boat. Lockley looked disgusted.

The lobster boat stopped at the island daily in the summer months bringing bird enthusiasts, mail and stores, except when the weather was bad. In the latter case all communication with the mainland was cut off for two or three days; once, Lockley told me, ten days. There was no telephone on the island, and an urgent message could only be sent to the mainland with the help of flashes from the lighthouse to the next island, which had a telephone.

The sailors looked askance at me and seemed shy and ill at ease. But after a great deal of sprightly effort on my part I finally got them to talk, though their conversation was not exactly fluent and consisted mostly in identifying the different sea birds that skimmed and plunged round us in the water. As I had packed my spectacles in my bag, this information was lost on me.

After an hour's journey we landed on Skokholm. At first glance the island was not prepossessing. It consisted mostly of bare and treeless moorland, rimmed round with steep red, striated cliffs against which the sea beat unceasingly. The landing place was a miracle wrought by nature out of the rocks of the cliffs; elsewhere there was not a place to land even a rowboat.

It was a lovely sunny day, and the air that blew in from the sea was warm and sweet. Birds darted in and out of the bracken as we made our way to the house; and underfoot the short turf was starred with the lesser celandine, and harebell, and a tiny flame-colored flower. As we approached the house we were met by a small, slender woman and a little girl of six, who were introduced as Mrs. Lockley and Lockley's daughter Ann. There were also Lockley's pleasant-looking sister and two women dressed in slacks and sweaters with cropped hair and a masculine outline,—student-assistants. These two, Miss [illegible] and Miss [illegible], were [illegible], [illegible] women, full of character and energy. They had come to spend a two weeks' holiday as guests on the island, and had liked it so well that they stayed on as student helpers. They were there that year from May to September (the normal season on the island) and went back again the next year.

I do not know why an island fascinates some people so much. Lockley and his wife never felt quite alive on the mainland. I remember asking Mrs. Lockley where they would go for their holiday.

"Oh, we shall go to the Blaskets this year. Ronald is writing a series of articles about islands."

I looked at the little woman with the wistful eyes: "I should think you'd like to go to London and be really gay."

She shuddered. "We don't like London. We feel shut up there. On an island you are free."

Good companions

At the end of the first day Lockley and I were friends. I had not shirked my duties, I had helped beat the bracken for migratory birds, I had washed up the luncheon dishes and shown Mrs. Lockley how to make fresh cottage cheese from goats' milk. I had energetically explored the island with my husband and Lockley and displayed an intelligent interest in the birds.

One evening, when I asked him how he happened to come to the island in the first place, he told me the whole story. He had been a sheep farmer on the mainland when he was a young man, but always in the back of his mind lay the desire to own and live on an island. When he found Skokholm, with its wide sweep of moorland, its untouched wildlife, its soft airs and remoteness, he knew he had found his heart's desire. He leased the abandoned farm, moved his flock of sheep there and began the life of a sheep farmer anew. But now something came to trouble him. He fell in love and wanted to get married. He had no home fit for a bride, for the old farmhouse was in ruins. It would take years to raise money enough to build a house. There was not a stick of timber on the island, and the expense of bringing it from the mainland was prohibitive.

"But I've always been lucky," Lockley said, with a smile. "One night the *Alice Williams* with a cargo of coal was blown ashore and broken to pieces on the cliffs. I bought the salvage rights for five pounds and got enough timber to build the house as you see it now and enough coal for four years. We hauled the coal up the cliff in baskets. It took a long time, but it was worth it."

He built the house with his own hands, and when it was finished he brought his bride to live there. I thought Mrs. Lockley must be a very brave woman indeed. Their little girl, Ann, was born and brought up on the island and knew almost as much about the insects, birds, and flowers as her father.

Presently Lockley began to turn his attention more and more toward the bird life on the island. Sheep farming did not pay, so he began to supplement his tiny income with articles about the birds and other wildlife on Skokholm. He wrote with charm and authority, and soon his income from his writings was sufficient to keep the little ménage going without the aid of the sheep. He sold them, and turned the island into a bird sanctuary. Most bird sanctuaries are financed and controlled by the great ornithological societies or by the Government, but Lockley was master on his island and kept his independence. He is now one of the foremost authorities on the migration of sea birds in the British Isles.

The original farmhouse was now the family headquarters and housed the women guests, while the old farm buildings provided a dormitory for the male guests and a combination kitchen and dining room. The food was delicious. There was always a huge leg of mutton or a great ham, a bowl of newly-dug potatoes boiled in their jackets, a great dish of broad beans or peas from the garden, salad, cheeses, hot scones, sometimes a pudding or fruit and junket, and when the lobster boat came in, a dish of fresh crab or lobster for tea. We ate enormously.

Little Ann looked after the goats, letting them out of the pen in the morning and rounding them up across the width of the island at dusk. She milked them, too, and tried to teach me, but I was slow, and animals always make me nervous. A backward glance from their wicked eyes frightened me, but Ann would shove the offending face away and go on with her milking quite calmly.

Banding

But we had come to study birds. Three times a day, after meals, the whole company was led out to the bracken clumps by Lockley. I used to protest loudly, especially after I had eaten a huge dinner, but Lockley had no mercy on me, although we were now friends.

The beating of the bracken was rather amusing. We all trailed down to the lower end of the clumps and ranged ourselves in a long line with about ten yards between us. We were armed with long sticks,

(Above) GANNETS in flight. Many of the birds are banded

Photos by R. M. Lockley

(Right) THROUGH THE AIRWAYS where these birds wheel in flight, engines of death now speed and man's peace-time conservation efforts must give way to the grim struggle for his own survival

BIRD STUDENTS find a unique headquarters on near-by Skokholm, six miles offshore. Below, R. M. Lockley, head of the Skokholm sanctuary, lends a hand in the banding of a one-year-old-gannet

Bowman photos

(Above) A FLEDGLING waiting for a meal. Besides gannets, Skokholm supports puffins, petrels, shearwaters, and various gulls

[illegible] toward the trap, [illegible] in the thicket. [illegible] the [illegible] He [illegible] trap. [illegible] chicken wire, quite spacious, which at the far end [illegible] into a smaller enclosure. When the birds had been [illegible] the [illegible] trap, a door was shut [illegible] through the door, drove the birds farther into a small cage about a yard square. When the door of this latter cage had been secured, Lockley went outside. Reaching into the interior through a long woolen sock, he extracted the frightened bird, banded one of its legs with a bit of metal stamped with the date and code number of the island, and let it go. Most of the birds, when we were there, were willow warblers and chiffchaffs. Occasionally we trapped a bird which had been ringed one, two or three years ago. That was exciting, for it meant the bird had visited the island before and was now returning on a migratory flight. These former visitors were always marked down specially in the logbook, since they provided valuable data on migration.

Once or twice (in the intervals between typing, cooking, and washing up) I went with my husband while he tramped the island looking for birds to film. It was easy to distinguish the puffins, those amusing big-beaked sea birds who sit about in orderly colonies like so many pompous old men in their clubs, dressed in dinner jackets and burbling quietly among themselves. Shearwaters and petrels were more difficult, though I finally learned to tell the shearwater by its flight.

The story of the shearwater

The petrel and shearwater lived in burrows in the ground made by the innumerable rabbits that infested the island. Lockley fetched out a couple of baby shearwaters for us to see and photograph. They were fat little balls of gray down, and loathed being brought out into the open, as the sun hurt their eyes after the darkness of their burrows. The story of the shearwater is the most fascinating of all. The chicks are hatched in the burrows about May and are fed through the summer by their hard-working and conscientious parents. They grow so fat that they can scarcely move, but there is wisdom in this. For one day, in the late summer, the parents fly away over the sea to the far south, and the baby chicks must now fend for themselves. For a fortnight or three weeks they wait patiently for the parents to come to feed them, until hunger finally drives them forth to the mouth of the burrow. They are thin now, and a good thing, too, for they could never fly in their [illegible] state of helpless [illegible]. At the mouth of the burrow they rest and [illegible] and wait for darkness to fall. Even the baby shearwater knows instinctively it must not venture out in daylight, since, owing to the awkwardness of its take-off, it cannot get into the air quickly enough to escape the murderous assault of the black-headed gull who preys upon it. When darkness comes, a true dark, not lighted by the moon, the little shearwater lumbers and half flies to the cliff's edge. It is a long, tiresome, and dangerous journey, and I fear many of them do not reach the sea before they are killed by the predatory gull.

Once at the sea's edge, these little birds, who have never flown, never seen the sea, and who have always had their food brought to them, launch out into the air and in that moment reach maturity, winging their way across the dark waters as adults in search of food. Their childhood is thus ended suddenly, and perhaps cruelly, according to human standards.

A midnight pursuit

The banding of the adult shearwaters was one of the entertainments of the island. It took place after dark, when the birds came home from their day at sea, uttering their wild, eerie shrieks unlike any other sound on earth, literally making your hair stand on end when you first hear them. At about eleven o'clock (for the shearwater will not come to land till daylight is gone) the first harsh cry would break the twilight stillness, and from then till early dawn the air was made hideous by the strange high-pitched cry of the returning shearwaters.

At about midnight when the noise was at its height we donned rubber boots and mackintoshes as a protection against the damp underfoot and the ministrations of the birds as they flew above and around us, and sallied forth into the darkness with torchlight and a pocketful of soft metal rings. The ground was pocked with rabbit burrows, and we stumbled and fell in the darkness, grumbling and laughing as we chased the birds. They were quite dazzled by the torch, and once you picked one up with the light it was easy to catch it, providing you seized it expertly around the body, far enough back so that the long neck with its sharp beak could not injure your hand with a vicious peck. Your partner would then come stumbling toward you, and between you the little ring, which was already entered in Lockley's logbook, would be clamped on.

I neither liked holding the scared and pecking bird nor fastening on the ring, but I found ringing was my job, willy-nilly. I was afraid that the thin struggling leg would break in my grasp, but somehow it never did. It was a weird experience—the pitch-dark night, broken by the flashes of torches, the shrill cries of the birds, the wet hummocky ground underfoot, the glimpses of rain-coated enthusiasts slipping and running in their chase after the birds. When the bird was banded, it was thrust down the nearest burrow, so that no one else would waste time trying to catch it. I wondered what the birds thought as they tumbled down a strange hole and found themselves in someone else's house, with someone else's hungry child.

The ringing went on for two or three hours, and then the party went back to the house, drank cider and ate biscuits, discussed the adventure and fell exhausted into bed to sleep the sleep of the healthily tired.

Sometimes one could corner Lockley in the late afternoon, and sitting in the sun, listen to his tales of other islands, of adventures on Skokholm itself, of birds and insects and their strange ways. I liked him immensely after my first encounter with him and admired his truly vast knowledge of his subject, his direct and uncompromising attitude towards life, and his undeniable charm. I have met few men who impressed me to the same degree.

Goat's hair for bait

At dusk my husband and I would take a couple of primitive fishing poles down to the cliffs and for an hour or two fish the deep waters around the island with a bait of white goat's hair. We never caught more than one fish each, but the pleasure of standing there on the slippery cliff base as the day waned and the mist rose against us far outweighed disappointment in our small catch. But one day a small yacht came into the bay and the owner, who was a friend of Lockley's, asked if anyone on the island would like to troll for mackerel outside the little harbor. My husband and I rushed down to the yacht at once and were given great trolling lines weighted with a two-pound lead. We started off in the motor-driven dinghy, circling round and round the blue waters of the bay. It was a fisherman's dream. I had only to let out my line to its full length to feel a heavy tug, and when I had reeled in, I had a fine three-pound mackerel. In a quarter of an hour I had caught eight of the beauties, and my husband an equal number. We concluded this was enough, in fact the wholesale slaughter became distressing after the first fifteen minutes. We took our haul back to the island, where we feasted next day on mackerel livers fried in butter for breakfast and broiled mackerel for lunch.

The highlight of our expedition was, of course, the visit to Grassholm. We set off one Sunday morning in a calm sea under a scorching sun. There were about a dozen of us—Lockley's five, three locals from the village of Dale (who had foolishly come in their best Sunday blacks for a day's outing and were made by Lockley to help with the banding, to the detriment of their clothes), the crew, and ourselves. It took about an hour to reach Grassholm in the lobster boat. When we scrambled ashore on the lee of the island, it looked like any other deserted place. The grass grew long and thick on the slope, a few gulls wheeled overhead, there was nothing to indicate that this was one of the unique places of the earth.

After disembarking with difficulty in the perilous little bay, we climbed toward a steep ridge, which divides the island sharply.

"What wonderful grass," I said, as I plowed through it to the summit.

"The birds used to be on this side," said Lockley. "You notice how the ground gives under your feet; it is honeycombed with old nests. The guano accounts for the richness of the grass."

I was feeling full of energy and bounded up the last few feet to the top of the ridge.

What met my eyes is really indescribable, compounded as it was of smell, sound, and sight. Owing to some strange arrangement of acoustics and wind currents, not an inkling of what one was to expect came till one stood on the summit. There, on the other side of the ridge lay a white mass of screaming, fluttering, flying birds stretching as far as the eye could see. Lockley says there are at least 40,000 of them.

The noise and the smell were terrific—especially the smell. The gannet feeds its young on regurgitated fish, and much of this was left by temperamental youngsters to decay in the strong sunshine of the eastern slope. Added to the excrement deposited by the 40,000 it created the smell of smells. The noise was augmented by our coming, which caused most of the great adult birds to leave the nests and swoop out toward the safety of the sea, uttering loud squawks of terror and indignation. The beautiful sweeping flight against the deep blue of sea and sky was unforgettable.

My husband, after several misadventures with recalcitrant film, got one reel of color-film of this flight, which is one of the loveliest things of its kind I have ever seen. In the film these great birds look like huge white crosses floating down the blue sky, diminishing in the distance to tiny specks like drifts of snow.

Birds of every stage were under our feet, from the newly-hatched, naked, helpless chick to the mag-

[illegible] white yellow-eyed adult with a wingspread of as much as six or eight feet. The ages in between were characterized by different plumage. The young of that year were white and fluffy and had not yet learned to fly and were the easiest to catch for ringing. The second-year chicks were a speckled gray; they flew well and had already been on their first migratory flight to the southern seas. The third-year birds were smooth and white again and very difficult to catch for banding. It took one person to hold each bird and another to do the banding. Nevertheless, our party succeeded in ringing 800 of them before we left the island.

The noise and smell suddenly sickened me, so I bade the others farewell and slipped across the ridge to the other side. There I lay in the luxuriant grass, completely out of sight and sound of the noisy, smelly mass of birds. I lay sleepily looking up into the sky watching the scattered gulls wheel over my head, uttering their muted cries.

It never occurred to me then that in three years' time there would be other birds streaking across the island, birds a thousand times the size of the beautiful gannets, carrying death in their steel bellies. No, it never occurred to me, for on an island one is safe and free from the impingement of a cruel and ill-adjusted humanity. The noise is of birds, not of bombs, the sky is full of wings, instead of steel; the rain that falls is beneficent, bringing life instead of death.

I did not think of death and destruction as I lay waiting on the grassy slope. I only thought how the study and protection of birds is one of the most peaceful, most interesting occupations. I resolved to come back again to Skokholm, to become a serious student of bird life, to learn a few salutary lessons from bird ways, to deepen my friendship with Lockley and others of his kind. White birds against a blue sea, and down below on the rocks some mother seals crooning their absurd babies to sleep.

But I never went back, and now the bombers make their way most days across the islands of Grassholm and Skokholm and the sea birds have been ousted from the sky by the giant birds of death. And yet—and yet—I think I *will* go back again, for the birds will return, and the islands remain, long after the bombers have crashed for the last time.

England is an island too.

(*Below*) SHEARWATERS feeding. These birds live in the rabbit burrows that honeycomb Skokholm. Parents feed their chicks for a time, then abandon them. The latter, then on their own and a ready prey to the black-headed gull, instinctively come into the open only at night. Once at the sea's edge, the little birds who have never flown nor seen the sea, launch into flight and become adults.

Photo R. M. Lockley

Mud, Stones, and History

The rise of N. C. Nelson from Danish farm boy to one of America's outstanding chroniclers of the life and times of prehistoric man

By D. R. Barton

In reviewing the career of Nels Christian Nelson, who has revealed so much of Man's past, one cannot easily avoid a feeling of special significance for the present highly critical hour in the world's history. His 35 years of unobtrusive scholarly achievement bear valuable testimony in refutation of the doctrine that stamina and intellectual leadership are the non-negotiable property of any one class or nation, and certainly his notable contributions to science may be numbered among the rewarding fruits of a free democracy.

His is, indeed, the familiar American success story of innate talent which secured opportunity for self-fulfillment within a fluid and incompletely stratified society and which made the most of that opportunity despite the towering barriers of language and poverty.

He was born not far from the site of the Battle of Jutland in a straw-thatched Danish farmhouse. Attending school during seasonal furloughs from his chores, he received an education sufficient at least to read admiringly of his immortal namesake, Nelson of Trafalgar and also to allow rapt absorption of J. Fenimore Cooper's novels. The latter stimulated a fondness for Indians which has not cooled to this day and which led him to dream often of coming to America where some of his relatives had already immigrated. This dream became a reality when in May of 1892 an aunt, living in Minnesota, sent him a steerage ticket to New York.

Half expecting to be greeted at the dock by the warwhoops of Indian savages, he became an obscure particle of the huge Atlantic Migration which had been furnishing new traits, skills, and attitudes to a burgeoning civilization for a hundred years and more. His horizons had lifted, and so determined was he to start life afresh that on sailing through the Narrows, he flung his old clothes out the porthole and faced Ellis Island inquisitors stripped of all that decency and prudence permitted.

When he had gone on to Minnesota, however, he found the daily round of the Danish colony little different from the regime he had left behind. On his uncle's farm he worked hard at the same old chores to pay off the expenses of his journey, but he soon perceived that if he were ever to become truly Americanized he would have to forsake the transplanted way of the homeland. Accordingly, he hired himself out to a farmer near the town of Marshall, Minnesota, where in five and one-half years he completed grammar and high school, finally graduating in the spring of 1901.

Kaiden-Kazanjian Photo

N. C. Nelson

To work one's way through school is difficult enough at best, but for young Nels it was a double triumph. At the age of seventeen he had to stand in the country schoolroom near his uncle's farm, spelling out c-a-t in the company of knee-high tots who had long since learned the spoken language. Possibly the need to overcome such handicaps opened up unsuspected reservoirs of energy. At any rate, he acquired a considerable reputation for scholarship and his friends and benefactors were anxious that he take up the traditional profession of a man of learning—the ministry.

It seems worth recalling at this point that Mr. Nelson's present colleague, Dr. William K. Gregory* was launched on his scholarly career with a similar end in view. And it is of passing interest that both fell in with the idea amicably enough at first.

A brace of pretty daughters in the home of his employer had enticed the youthful Nels to spend a good deal of his time around the church, which was the center of social life. But midway through high school he struck a snag. Physics, chemistry, and botany were included in the curriculum and it was here, as he says, that "the trouble started."

His Latin teacher, who also taught botany, accused him of jilting irregular verbs for stamens and pistils, and as time went on his inclinations drew him farther away from the classics. Then, too, various scientific concepts encountered in the laboratory seemed to contradict standard theological explanations of the universe and this conflict, which troubled his soul no little, he was determined to resolve in college.

According to the schedule friends had laid out for him, his higher education was to be pursued in a nearby denominational college. But at this time a family of Californians, sojourning in Minnesota for health reasons, were about to return to their native state. They sang the praises of the latter as only Californians can, and persuaded Nels to go along. The nine-day trip was made in a freight car filled with farming implements, household goods, and a variety of livestock. Transportation was free in exchange for Nels's services as stock tender.

Philosophy

The problem of acquiring the wherewithal for his higher education was with him late and soon. But in

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* See "The Evolution of an Evolutionist," by D. R. Barton, Natural History, April, 1941, p. 234.

[illegible] Nels [illegible] butchering crew, taking special charge of the lard-rendering process. He stuck to this bloody business until he had accumulated sufficient funds to enroll [illegible] Stanford University, whose sages he then called upon to set at rest his inner doubts.

The leap from butcher's block to philosopher's stone was negotiated nimbly enough, but he had not penetrated very far into the wisdom of the ages when Stanford's only professor of philosophy accepted a chair at the University of California in Berkeley. Left with the choice of discontinuing his quest for the meaning of meaning or following suit, Nelson decided to transfer his allegiance also. At Berkeley he plunged even more deeply into cosmic mysteries, only to be confronted by such abstruse concepts as Kant's Doctrine of the Transcendental Ego of Apperception. His professor was sympathetic but not particularly helpful. He himself had read Kant 26 times without being able to achieve anything beyond a man's bewilderment.

It was not long before Nels began to realize that he was getting nowhere rapidly. Better men than he, it appeared, had been wrestling with the problem of the universe with very little in the way of successful solution, and he decided that the best way out of his conflict was simply to ignore it.

More or less out of a sense of obligation, he took courses at the Unitarian seminary, but he abandoned all notion of going into church work from the moment he was bitten by the anthropology virus.

Quite by accident, in 1906, he accompanied a friend on an archaeological expedition to dig up an old Indian cemetery, near Ukiah, some distance north of San Francisco Bay. Immediately thereafter he signed up for all available courses in anthropology, feeling that at last he had found his metier.

Sudden though this conversion seems at first blush, it probably derived its lasting effect from an inherent susceptibility. For almost a decade earlier he had been tremendously impressed by a graphic historical display of Man's tools arranged in chronological order, which he chanced to visit at the Omaha Exposition of 1898. In the same building a collection of Indian artifacts was also on exhibition as mere curiosities it is true, but for all that no whit less stimulating to a boy who had grown up in the fanciful company of Leatherstocking and Chingachgook. Had the science of archaeology been at all publicized in the Middle West of that day, it is quite likely that Nelson would have hitched his wagon to its star then and there. But though his imagination had been profoundly affected, the notion that a man could live by studying the evolution and distribution of potsherds, arrowheads, and axes simply did not occur to him. Nevertheless the idea had been planted in the back of his mind and when he delved into his first shell mound on the shore of San Francisco Bay, the seed burst into full flower.

Here, it seemed, was more substantial food for thought. Archaeology had about it no stale odor of the recluse, no abstract will-o'-the-wisps of otherworldly minds. It was most emphatically of this earth, and most emphatically material. Mud and stones. The one molded and baked to form a food pot, the other chipped and sharpened into a deadly weapon — the winged bomb of its day — with which to keep that pot always filled. This was archaeology. By carefully studying a handful of flint spearheads and a few scraps of pottery, one might push back the horizons of history. And how it broadened one's vision! All Man's inventions were but links in a seemingly endless chain, and the creation of a pointed stick for digging up roots was relatively quite as marvelous, quite as important to Man's destiny as the airplane or the radio.

Equal portions of field work and laboratory study prepared him finally for work in the Museum of Anthropology conducted by the school at Berkeley, where he became an Assistant Curator after his graduation. His master's thesis took the shape of a report on an archaeological survey of the entire San Francisco, San Pablo and Suisun Bay shore, over which territory he walked more than 3000 miles, according to his pedometer, and located about 400 shell mounds.

All this time, Nelson was still earning his way in true Alger fashion. He had been getting up at five every morning to punch the clock in a local bank where he served as a sort of combined janitor and office boy, doing everything from dusting the president's desk to picking up the money that was left scattered around the tellers' booths after a busy day. He admits that this apparent carelessness may have been calculated to test his honesty. Suffice it to say he never tried to find out.

One morning his alarm clock went off at five as usual and he was about to dress when quite to his astonishment the bookcase on the opposite side of the room fell over and with a thundering crash slid under his bed. To his further astonishment, the room then proceeded to rock like a ship in a storm, the walls cracked and the plaster fell about his ears. Sizing up the situation as hopeless, he decided that struggling young archaeologists as well as generals could enjoy the ultimate luxury of dying in bed. Nothing further happened, however, and he dug himself out of the debris, dressed, and went out to join the excited crowds on the street.

He was, of course, in the midst of the celebrated San Francisco earthquake of 1906, and distinctly worried about the safety of a girl friend who was teaching in San Francisco. A mutual, influential friend obtained for him a pass signed by the governor, himself, enabling him to cross the Bay. To obtain it, however, he stretched a point, claiming that Nelson was going to rescue his wife. On the third day of the fire the lady and some of her valuables were safely landed in Berkeley.

Museum curatorship

Some of Nelson's studies were carried out under the direction of Doctor Pliny E. Goddard, a noted anthropologist on the coast, and subsequent American Museum curator, who shared with Nelson and Gregory the "original sin" of having started out destined for the ministry. Indeed, Goddard was once a missionary to the Indians. But the latter were evidently possessed of much more persuasive tongues, for he ended up as an enraptured student of their languages.

Goddard was so impressed by Nelson's ability that he made an effort to bring him east soon after his own appointment to the Staff of the American Museum. His erstwhile protégé was, however, quite happy on the coast, and did not yield until a promise of major archaeological expeditions to new fields in the Southwest proved too much for his powers of resistance. Accordingly, Nelson packed up bag and baggage and came to New York in 1912 as Assistant Curator of Prehistoric Archaeology, convinced that the opportunity for the concentrated work he so desired was now at hand.

This turned out to be true enough. But he was enjoined to concentrate on a project far removed from what he had anticipated. For at this time, Professor Osborn, versatile President of the Museum, had developed a passionate interest in European archaeology and was determined that this field should be worked over at firsthand by a competent representative.

However competent he may have been, Nelson was at this time anything but an authority on Old World archaeology. But, orders being orders, he made up his mind that if he was not going to see America first he might as well bone up on the European literature and devote himself to investigations on foreign soil. Presently he was taking part in extensive excavations in the Castillo cave in Spain and visiting famous archaeologists in all the countries of western Europe, including his native Denmark.

To China and back

During the years that followed, he made several more extended European trips, visiting all the important museums and many famous archaeological sites. The work in the American Southwest went on in the meantime—with conspicuous results to be treated in detail later. Thereafter he grovelled in the murk of Kentucky and Missouri caves, and even sampled the shell mounds of Florida, for which heretical act his California friends may never forgive him.

Then in 1925, Nelson ventured upon a new continent—Asia—while serving as archaeologist for the Central Asiatic Expedition under the leadership of Roy Chapman Andrews.

He had been out in the Gobi only a few days with the main caravan when he came across his first find in this unexplored region. Here at last Nelson could satisfy his itch to sink a shovel in absolutely new territory. But the Central Asiatic Expedition had so rapid a production schedule that no one was allowed to tarry very long in one place.* And neither time nor equipment was available to apply the rather ponderous if thoroughgoing method of stratigraphic excavation to the Gobi.

It was during this trip that Nelson was first confronted with serious danger—the price one often has to pay for being the first to explore new vistas. Various members of the expedition, to replenish the camp fare, regularly hunted antelope wherever available and thereby aroused the hostility of the Mongols, who were anxious for any excuse to strong-arm the intruders. When these formidable-looking roughriders came roaring down out of the desert hills, Nelson arrayed himself with the other members of the party in a tightly drawn knot which bristled with repeating rifles. The muzzles of these pieces evidently looked a little too minatory, for the lords of the desert calmed down quickly enough and even stayed for supper. On another occasion, Nelson completely overawed the always truculent Mongols by pretending to be a magician, able to remove his (artificial) eye and put it back again.

Like his paleontological colleague, Walter Granger, Nelson left the Gobi in winter for milder, if no less belligerent, climes along the Yangtze river and like him also ran a gamut of rifle fire from the skirmishers along the banks. He had come to these famous Yangtze Gorges for the purpose of examining the numerous caves situated in both cliff walls, a project which, though archaeologically almost fruitless, marks one of the most romantic episodes in his life.

Accompanied by Mrs. Nelson, he sailed upstream some 400 miles on a picturesque, high-poop-decked Chinese junk, complete with captain, crew, and servants—in all, 22 people. As Nelson trod the "quarter-deck" in the role of supreme commander, his mind harked back to the famous historical figure for whom he was nicknamed in high school days. Bonaparte's fleet might be lurking nearby, and in that bellicose atmosphere, Trafalgar Bay could well lie around the next bend of the river.

In any event, the "Admiral" expected that every Chinaman would do his duty. Nor was he disappointed, for the crew deeply appreciated the security of sailing under the American flag. As with Granger's coolies, they lived in constant dread of being shanghaied for transport purposes by sundry local militia. Indeed their boat was robbed and most of the sailors taken prisoners the moment the Nelsons departed. But no mishap of major importance occurred on the trip itself, and Nelson was able to land whenever he chose to examine caves or survey small tributary valleys—all the while trying to put himself in the position

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* See "The Way of a Fossil Hunter," by D. R. Barton, NATURAL HISTORY, March, 1941, p. 172.

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[illegible] mouth of or in the interior of the cave he would proceed to dig for whatever [illegible]

[illegible] considerable assemblage of artifacts in the Gobi as well as along the river banks. After fully two months of river sailing, the Nelsons joined the Grangers at winter headquarters in the temple of the T'an family, above the treaty port of Wanhsien, where paleontologist and archaeologist joined forces to inspect the neighboring fossil quarries. To get out of the war-torn interior all were obliged to sail down the Yangtze to Shanghai; but the next winter they explored the banks of the Yangtze again, some 800 miles further upstream in Yunnan Province.

Contributions

Such, in bare outline, is the record of Mr. Nelson's wanderings in quest of the raw materials of his science. But if we are to gain some idea of what he has done with this material, what in short have been his contributions to archaeology, it will be necessary to say a word about the state of that branch of science at the time when he first entered its lists.

Nearly all the sciences founded upon the collection and serial study of physical objects began as hobbies, and archaeology is no exception. Dignified by the name of "antiquarianism," it contributed odd collections picked up here and there, which were preserved as engaging curios. Indeed, the chief distinction between the antiquarian and the archaeologist lies in the organization of materials. The latter goes beyond simple curiosity in an effort to interpret his collections and to arrange them in their natural order, so that new chapters in the vast unwritten history of our race may come to light.

Few people realize the relative novelty of this approach. Before Columbus, artifacts were regarded as not merely curious but supernatural. They had, it seemed, been deposited on the earth for some divine reason or other but had little to do with Man himself, in a material sense. Then gradually as more and more travelers began to encounter the red man in America, the brown man in Polynesia, and the black man in Africa, European culture was confronted with its primitive self in the flesh. Here was the Stone Age in [illegible] ingly evident that European Man had himself once been a savage, and in the acknowledgment of this fact lay the [illegible]

But [illegible] itself did not blossom out of the antiquarian soil until the development of the stratigraphic method of excavation—which, at its simplest, operates on the theory that artifacts are deposited in definite layers of gradational antiquity, the oldest stage of a given culture being represented by that layer which lies deepest below the surface.

Nelson has the distinction of being the first to apply this principle to excavations on the American continents. But accident, it must be admitted, played a part in this attainment.

Some years before Nelson investigated the pueblo area of the Southwest, a competent American Museum archaeologist, George Pepper by name, was sent out for the specific purpose of ascertaining whether or not the stratigraphic method would work in this particular region. Most acute observers expected it would. But when Pepper chose a site and began to dig, he found such a confusion of early and recent objects at all levels that he felt compelled to turn in a disappointing verdict. This report set back archaeological investigation for some years. Still, Doctor Wissler, Curator of Anthropology,* was not satisfied. He felt certain that stratigraphy must work in the New World as well as the Old. Accordingly, he sent Nelson out to investigate the matter and a few months later the mystery was solved. A group of recent Indians had moved Pepper's site, and, unknown to him, disturbed it to such a degree that it was spoiled for archaeological purposes. Nelson then chose a different site in the same locality and found that the stratigraphic method worked perfectly.

From the moment Nelson reversed Pepper's decision, so to speak, Southwestern archaeology began in earnest. But his most important contribution had yet to be made. Paleontologists had been noticing for some time the tendency of their material to lie diffused outward from an apparent center of origin. Later on, Doctor Wissler and other ethnologists had proposed the idea that the Indian horse culture had also diffused from a central point in a configuration which is perhaps best imagined by throwing a pebble into a smooth body of water. The resulting concentric circles of ripples flowing outward illustrate what is apparently the natural course of the geographic dispersion of any human culture.

It was left for archaeology to put this hypothesis to the acid test, and the Southwest was the ideal place to do it. For here a wealth of prehistoric pottery lay buried, and of all archaeological materials pottery is the most sensitive to change.

Human fancy has ever been so fickle that pottery styles differentiated almost as rapidly as the design of female headgear in our own day. Thus even in prehistoric times every culture worthy of the name had its "capital of fashion" and one could always tell a provincial by the fact that he was using last year's pot. Moreover, Nelson was able to show that the further one journeyed into the surrounding "provinces," the more out-of-date the pottery style became. And the pottery was a reliable index of the general scale of living.

His method was simple. Wherever excavations penetrated deep enough to indicate that a ceramic "capital" had once stood on that particular spot, Nelson obtained sample fragments from each stratum, thus charting the ***vertical*** evolution of styles. Then shallow diggings were made at various distances away from the capital in several directions. These revealed a ***horizontal*** evolution of the same styles which corresponded remarkably with the vertical gradation. The procedure could be repeated at increasing distances away from the capital until the potsherds bore resemblance to only the most primitive relics found at the center. Here then, the outward spread of the culture by trade, conquest and other agencies might be assumed to have ended. This Age and Area hypothesis, as it is called, is simply another way of saying that the oldest inventions have spread the farthest, and that even if out on the margins some of the old primitive inventions still survive in use, in the center of origin they are deeply buried, as it were, below later inventions.

Once Nelson verified this working principle of Age and Area, anthropologists recognized that it applied not only to particular cultures but to hemispheres as well. [illegible]

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*[illegible]

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

1. What bird "flies" under water but not in the air?

2. The Texas longhorn was
- (a) A breed of cattle
- (b) A saddle used by cowboys
- (c) A mock trombone used by Sam Houston

3. Breaking off the fangs of poisonous serpents renders them permanently harmless.

True. . . . . . False . . .

4. What tree gives material for houses, clothing, cordage, mats, fish nets, food, drink, and soap?

5. What is the so-called "garden" in an emerald?

6. In the lack of sun glasses why would gladitorial contests have appeared green to Nero?

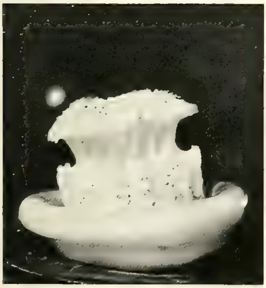
7. Is there any authentic record of a bird literally kicking a snake to death?

8. *Tiphia vernalis* is a
- (a) Most dreaded type of typhoid fever
- (b) An exterminator of Japanese beetles
- (c) Green mold that attacks hibernating bears

9. An octopus has
- (a) One eye
- (b) Two eyes
- (c) No eyes

10. Is the object *(below)*
- (a) A rare mushroom
- (b) A drop of milk photographed with high-speed camera
- (c) A living animal
- (d) A part of a flower

WHAT IS IT? An unusual photograph taken by Anthony V. Ragusin. (For explanation see Answer to Question 10.)



ANSWERS TO QUESTIONS

1. The penguin. See page 298
2. (a) A breed of cattle, now virtually extinct. See page 300
3. False. Unless the embryo fangs are taken out the defanging is not permanent. See page 283
4. The coconut tree. See page 254
5. The "garden" in an emerald is an aggregation of cracks and flaws, apparently the result of internal strain. See page 275
6. Because Nero viewed the contests through an emerald, in the belief that it would relieve eye strain. See page 275
7. Yes, it is the habit of the secretary bird to kill its prey by vigorous kicking. See page 265
8. (b) An exterminator of Japanese beetles. *Tiphia vernalis*, a digger wasp, is a strong ally in combatting this common pest. See page 268
9. (b) Two eyes. See page 258
10. The object in the photograph is a living animal and is a foot in diameter. It proves that curious creatures which are rarely seen by the average person inhabit the sea in great abundance, for this "cup fish" often occurs in vast swarms, occupying an area that is sometimes over 100 miles in length. It belongs to the jellyfish family and is scientifically known as *Stomolophus meleagris*. In the photograph it is actually upside down, so that you now view it in a more nearly normal position, though the body is somewhat compressed by its own weight. It floats near the surface of the sea and may be found anywhere off our southeastern coast from Chesapeake Bay to Mexico and beyond.

ANSWERS

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[illegible]

EUROPEAN NEWTS

PENGUIN AND FISH —a remarkable photograph of a bird that "flies" underwater but not in the air

[illegible]

Nature *through* THE CAMERA'S EYE

TELESCOPE FISH—a breed of goldfish, said to have originated in China but best developed by the Japanese

Photo by Unger

A PAIR OF ANGELFISH
—velvety stripes on a background like quicksilver

Photo by Unger

YOUR NEW BOOKS

THE HISTORY OF MEDICINE ● AN ADVENTURE ANTHOLOGY
LONGHORNS OF TEXAS ● KABLOONA ● STORY OF THE EARTH
WOLF CHILD ● MAINE BIRDS ● GOLD RUSHES ● FRANK BUCK

MEDICINE AND HUMAN WELFARE

by Henry E. Sigerist

Yale University Press, $2.50

AMONG [illegible] and hostile spirits. Since spiritual and [illegible] the function of religion to combat and hold in [illegible] From this beginning, our modern medicine has gradually evolved. The Greeks were the [illegible] the Romans began the [illegible] and state control of the physician; Christianity brought to medicine the ideal of service to all, regardless of position or wealth. The modern period with its emphasis on science and its industrial-capitalist society has created a scientific and competitive medicine. But medicine, as we know it, has not yet achieved its final evolution. Already the signs are evident that medicine [illegible] greater integration with the social structure. The highly complex, modern community has developed needs which are eventually bound to affect medicine.

To make clear this recent trend, Professor Sigerist has devoted these Terry Lectures to the analysis of the history of medicine. He has traced the movement by reviewing three of its aspects: illness, health, and the physician—describing the changing attitude toward each from antiquity to the present. Professor Sigerist, therefore, gives us the past of medicine to adumbrate its future. The book is authoritative, scholarly and of wide interest.

H. L. SHAPIRO

BIRD ISLANDS DOWN EAST

by Helen Gere Cruickshank

Macmillan, $2.50

IN this account of the little oceanic islands lying off the coast of Maine, Mrs. Cruickshank has combined exciting personal adventure with good, solid natural history information. These islands, steeped in folklore, are in some cases practically isolated from civilization except for a stoic old keeper and an ancient lighthouse, or they may be completely deserted [illegible] Some are far at sea, others are close inshore, but all [illegible] of the bird inhabitants which find their last [illegible] gly cliffs and in their gnarled old trees.

In company with her husband, the author has spent many summers visiting these little-known dots in the sea in order to study and photograph the sea birds which breed upon them. Her descriptions are so vivid and picturesque that a strong desire to see these things is kindled in the reader—one contemplates the coming vacation. To those who have never taken a particular interest in birds, this book will reveal a sparkling new field both in adventure and in science. The 50 photographs are on a par with the text. They were selected from among the hundreds of pictures which Mr. Cruickshank, one of the country's leading bird photographers, has taken.

This book will appeal to all who know the New England seacoast and who love the sight of "the great cliffs and boiling surf that crashes against the rocks in an unbroken sweep from Portugal." It will appeal to the bird enthusiast because of its fine descriptions of the breeding habits of puffins, cormorants, petrels, ospreys, arctic terns, great blue herons, herring and laughing gulls, and other birds. It contains much interesting information on the migration, banding and conservation of sea birds by the Audubon Society. Quaint superstitions, odd-named islets, historical background, all are expertly woven into the story of these sea birds and of the Todd Wild Life Sanctuary at Hog Island where the Audubon Society maintains an ideal summer camp for bird students. Indeed the reader, in company with the author and her husband, will find the coast coming to life as "the days inexorably pass and each beloved facet of the many-sided Maine Islands takes on a new and poignant appeal."

F. L. G.

THE LONGHORNS

by J. Frank Dobie

Little, Brown, $3.50

THE Texas longhorn is an interesting animal with a romantic history. The great expanse of horn, with its bold, purposeful pattern, has always intrigued the beholder as a marvelous example of maximum development. The history of the breed is closely interwoven with the conquest and growth of the Southwest. Texas today owes much to this hardy strain of pioneer cattle, but the longhorn itself has virtually disappeared from the scene and is a museum rarity. Dobie knows his Southwest, he writes well and his sympathy with his subject is evidenced by the vast amount of detail he has brought forth from many sources. Anyone who reads this book will get a very good cross-section of the western memoirs which grew up about cattle.

One of the greatest contributions of a book of this sort is the placing upon record of data likely to be lost with the passing of a generation. The old timers knew at firsthand a great many things that the passage of time has removed from common knowledge. Their descendants can learn of them only as some historian searches out the hearsay and winnows the wheat from the chaff. This is not a book to be read at a sitting. It has plenty of highlights, action and anecdotes, but in between them are historical passages, and the animal is not a mere excuse upon which to hang a framework of episodes. The lawlessness and violence of the Southwest are logically associated with the longhorn, but these are only side issues. The settlement of the territory, the growth of the great herds of cattle, the impress of the longhorn upon the people themselves, all of these are mass developments which overshadow outlaws and gun-men.

The illustrations, by Tom Lea, are excellent. They feature the graphic possibilities of such a dynamic subject without undue exaggeration.

H. E. ANTHONY

KABLOONA

by Gontran de Poncins

Reynal & Hitchcock, $3.00

I CANNOT regard this book objectively, for it happens that I have seen much of the country it tells about and am personally acquainted with a number of its principal characters, both white and Eskimo. I have read it with keen critical interest, admiring its high literary quality throughout.

Unfortunately, it contains too many exaggerations, half-truths, and misleading statements to be taken seriously for its Arctic lore. It can be properly enjoyed only as a study of a cultured and romantic Frenchman's reaction to, and interpretation of, life among primitive Canadian Eskimos.

Count Gontran de Poncins arrived at what he poetically calls the Glacial Sea with a determination to live the Eskimo life and understand the Eskimo mind; and he at once assumed that the white traders, trappers, missionaries, and Royal Canadian Mounted Police he met there were lacking in the ability or inclination to do likewise. He came "to penetrate into a world to which they were indifferent."

Practically ignoring the scores of explorers, traders, and Mounted Policemen who have examined King William Island and Boothia Peninsula since the middle of the nineteenth century, he fancied himself as very nearly the first white man to hobnob with most of the Eskimos of that area.

Some of his best introspective and analytical writing covers his relations with the manager of the Hudson's Bay Company trading post at King William Island (albeit in doubtful taste) and the ascetic priest in an ice-house at Pelly Bay. But his descriptions of Eskimo folkways, although fascinating, are often shockingly distorted. Indeed, it is only the author's personality that emerges in true perspective.

RICHARD FINNIE.

HIGHROAD TO ADVENTURE

- - - - - - Edited by Earl P. Hanson

McBride, $3.00

IN his Introduction, the Editor maintains that to be good an anthology must have direction and point of view. He considers that the greatest adventures occur in the pursuit of some serious objective and represent a spiritual triumph in the face of material defeat. The material he has selected for this adventure anthology holds very closely to his definition of adventure and is wisely edited. The stories have been drawn from the writings of 22 other authors, among them such well-known names as Churchill, Stefansson, Lindbergh, Courtauld, Holdridge, Sheean, and Dana.

Geographically, Mr. Hanson has succeeded in covering the world from the Arctic to the Antarctic, including all the continents; while the stories are distributed over the period from the sixteenth century to the present, with most of them dated after 1900. Four of them deal with aviation, five with the sea, six with wars, and the rest include exploration, mountain climbing, engineering, and hunting.

It is a thrilling collection, and we are indebted to Mr. Hanson for making so much that is worth-while available in one volume.

JUNIUS BIRD.

THE GOLD RUSHES

- - - - - - - - by W. P. Morrell

Macmillan, $3.00

IN the belief that there is more to history than battles and kings, the publishers have instituted a series of works, known as "The Pioneer Histories," which discuss the expansion of European enterprise. Each recounts the history of some important movement. In the present volume we find an account of the search for gold and the new settlements which accompanied each new find.

After a brief summary of the ancient conquests of golden treasuries, we find descriptions of the gold discoveries in Brazil, Siberia, California, British Columbia, the Rocky Mountain States, Australia, Africa and Alaska. Here are interesting anecdotes which spice the administrative and legal aspects of the exploitation. The consistency of man through many lands and many years makes similar patterns at Beresovsk and Ballarat,—always to many the gold was a scourge, not a boon. Falling yields made governmental taxes equally unbearable in Brazil and Bendigo, and the hardy miners were ever quick to protest. But after the rushes and after the fights, when quiet ruled the land, many territories were better off, with more inhabitants, more improvements and fewer hazards, prepared for further, normal growth.

The book is well illustrated with numerous, attractive outline maps. Although fundamentally about gold; silver, copper and diamonds find a place. So intertwined are our natural resources that few may be considered alone. The South African gold rush followed diamond discoveries which had already created scenes similar in all but the actual loot; there as elsewhere, rush, boom, inflation and panic were again the old familiar sequence.

The bibliography at the close of each chapter, with the author's comments upon the cited works shows how authoritative each discussion really is, and nowhere will there be found such a wealth of information and such thought-provoking suggestions of the influence of the gold rushes upon modern empires and modern struggles for wealth and power.

F. H. POUGH.

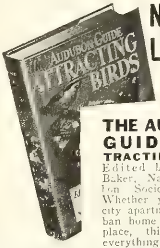
WOLF CHILD AND HUMAN CHILD

- - - - - - - - - by Arnold Gesell

Harper, $2.00

THIS vivid little book is an interpretation by a noted specialist in problems of human growth, of the diary of missionaries who found and re-educated an Indian child who had spent most of the first nine years of her life among wolves. The author describes the "wolf" habits which the child had learned: to prefer the dark and shun the light, to run on hands and knees or hands and feet, to tear food and explore with her mouth, and to utter a strange wolf cry at stated periods during the night. Kamala and a younger child, who had also been stolen and reared by wolves were brought up in a missionary orphanage, where they gradually learned human ways. The missionary's wife was a trained masseuse and her skilled hands played a significant role in re-educating the body of this child, who had learned in her flexible infancy to behave like a wolf instead of a human being. The old habits died very slowly. For the first two years, Kamala would sit all day with her back to the other children; at night she roamed about. She refused clothing and would not take food from human hands. When she died at seventeen, she had learned to walk upright, although she never learned to walk gracefully or to run. She wore clothes, performed simple tasks about the orphanage, cared for the babies and spoke in simple sentences.

The well-authenticated story is an impressive illustration of man's almost incredible power of learning. This human child had managed to learn wolf ways, to which her body was not naturally adapted; torn from her wolf home, she later learned



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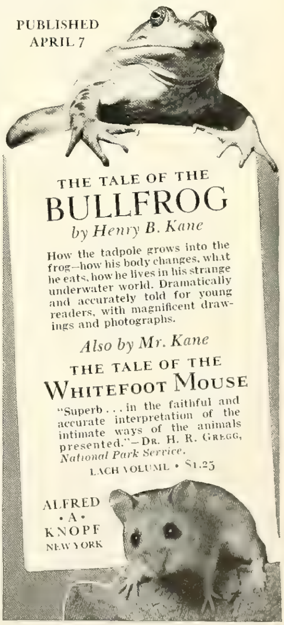

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SEX AND RACE

by J. A. Rogers

J. A. Rogers [illegible], N. Y. [illegible]

THE [illegible] of the Negroes with [illegible] var-ious non-Negro stocks. Others seek to [illegible] of Negro admixture and its genetic significance. But to the historian and to the scientist the evidence is indubitable that such admixtures have taken place, varying in amount according to place and time.

Mr. Rogers [illegible] dealing with Negro miscegenation only in the Old World, to indicate the scope of the phenomenon. Since the process of mixture is undeniable and its evidence accessible, it is unfortunate that the author has been uncritical both in his choice of authorities and in examples. Interpretations of considerable license and discredited writers of no standing jostle unimpeachable witness. Such indiscriminate use of evidence can only injure the measure of truth which exists in the author's thesis. By strict adherence to the soundest criteria, Mr. Rogers might have proved much by demonstrating little. He has in fact weakened the little by claiming too much.

H. L. S.

WHEN THE WORLD WAS YOUNG

by Martha McBride Morrel

Houghton Mifflin, $3.00

IN a Foreword to this book, Professor L. C. Glenn of Vanderbilt University says, "In the field of geology I know of no book by a technically trained geologist that succeeds in telling the story of the Earth and its life in a simple, straightforward way that keeps one's interest sustained throughout the entire reading.

"We should then welcome anyone who, like the present author, has the ability to clothe the facts of our science in attractive garb and tell the story in such simple terms and with such deft touch as we find in the following pages."

This reviewer fully agrees with Doctor Glenn's praise of this work. The story explains the origin of the planets on the basis of the tidal disruption theory, traces the earth's development until it becomes habitable, and then outlines the history of life on it. Emphasis is on the development and early history of man and only the spectacular side lines, are treated in detail.

The illustrations, by R. E. Falconer, are, on the whole, adequate though the scale is not always correctly indicated (*Diatryma*, for example). More serious is the conflict between the text and the terminal "Chart of Geologic Time" in the relative number of years assigned to the various periods and eras. In the text (p. 88) Paleozoic era is said to have begun 450 million and the Cenozoic era (p. 184) 4 million years ago. In the chart they are 550, and 55 million years ago! Paleontologically speaking such age discrepancies are but the expression of our uncertainty in this matter, but here, where the author indicates the relative relationship of events solely in terms of "years ago" the reference use of the chart becomes misleading. This error can easily be corrected in subsequent editions.

Here is an exciting story, thrillingly and enthusiastically, but simply, told.

H. E. VOKES.

ANIMAL BEHAVIOR

by J. A. Loeser

Macmillan, $2.00

PROFESSOR LOESER rightly objects to explanations of animal behavior involving "the assumption of a pre-formed mechanism which functions with unconscious purposiveness and pursues and attains a specific biological aim with automatic certainty." He believes, on the contrary, that the behavior of animals is a product of learning and individual experience. Unfortunately this interesting thesis is supported almost exclusively by anecdotal evidence and anthropomorphic speculation. To assert that the amoeba possesses consciousness and seeks out pleasurable sensations does not add to a general understanding of the reactions of unicellular organisms. The description of a mother bird's care of her brood as "altruistic in the uusual sense of the word" contributes nothing to our knowledge of bird behavior.

Misstatements of fact detract from the book's interesting accounts of the habits of animals. The parturient kangaroo is said to use her lips in transferring newborn young to the pouch. Recently published observations discredit completely this long-accepted belief. According to Doctor Loeser, even reproductive behavior is learned rather than instinctive and cannot occur without previous experience. Such a statement reveals ignorance of numerous experiments proving the normality of mating behavior of animals raised in isolation.

The purpose of the book is creditable, but its actual contribution is small.

FRANK BEACH

INSECTS AND THEIR STORIES

by Harry Hoogstraal with camera studies by Melvin Martinson

Crowell, $2.00

FORTY-SIX insects or groups of insects are discussed rather briefly, and each discussion is accompanied by a reproduction of an enlarged photograph. Some of these reproductions are decidedly lacking in detail. The text is apparently intended for those who know little or nothing concerning insects. As such, it may well serve as an introduction to the habits of some of the insects that are frequently noticed. The dimensions of the pages, 9.5 inches wide and 7.5 inches high, makes an awkward format that does not fit well in ordinary bookcases.

ALL IN A LIFETIME

by Frank Buck with Ferrin Fraser

McBride, $2.75

As the name implies, this book is Frank Buck's autobiography. Born in the state of Texas, in a wagon yard owned by his father, Frank Buck always felt a desire to see what was beyond the horizon. As a boy he tried his hand at cattle raising, but the urge to move farther afield was in him and when a chance came to deliver some cattle at Chicago he jumped at the opportunity. While working as a bellhop in a hotel at Chicago, he met Amy Leslie, a dramatic critic on one of the Chicago newspapers. They were later married, but only after he had secured another position with a music publishing house. Through this union Buck became acquainted with many prominent theatrical celebrities, which stood him in good stead during his later life.

But the call to far horizons was strong and when an opportunity came for a trip to South America he broke off all his relations in Chicago and departed. He amassed a considerable collection of birds and animals and had no difficulty in disposing of them when he returned to the United States. And thus the career was begun which was to make Frank Buck famous. Since that time he has brought back many thousands of mammals, birds, and reptiles, chiefly from the Malay Peninsula and India.

Frank Buck is not only a good collector but also a good showman, and the latter trait undoubtedly contributes to his popularity. His three pictures, *Bring 'Em Back Alive*, *Wild Cargo*, and *Fang and Claw*, were very popular. In making these pictures he resorts to all sorts of devices that might be fair in Hollywood but are not considered true natural history. I have been in the locality where some of his pictures were taken, and this fact is common knowledge there.

The book is written in an entertaining vein and holds the interest of the reader throughout. Numerous pictures, chiefly of Frank Buck, illustrate the book. T. D. C.

MUD, STONES, AND HISTORY

Continued from page 296

Taking the continents of North and South America as a whole, we find that the highest and most stable culture occurred in Central America. By the same token we also find that our most primitive and least stable cultures are found at such opposite extremities as Tierra del Fuego to the south, and certain Eskimo lands to the north. Prior to the time Nelson was able to develop the concentric circle scheme of cultural Age and Area, it had been supposed that Tierra del Fuego was a recent culture. But according to the new hypothesis, such is not the case. The natives of Tierra del Fuego all represent the outermost southward ripple resulting, so to speak, from the stone thrown in the water of the Mexican corridor. They are therefore the least affected by pre-Columbian achievements and represent approximately the selfsame cultural level at which primitive man had arrived when he reached the American continent.

Nelson is of the opinion that these original tribes came over by way of the Bering Straits, some 12,000 years ago. Although he is not unappreciative of the scattered cultural evidences suggestive of occasional immigrants from Polynesia to the American coast, he feels that their traits obviously arrived in relatively recent prehistoric times and have no bearing on the original peopling of the American continent.

The future

A man who has done so much for the science of archaeology can well afford to sit back at this stage of the game and speculate as to what may happen to that science in the future. Archaeology has been so publicized of late that he feels too much attention has been paid to the supposedly romantic field work and not enough to the prosaic classification of the collections once they are housed in the Museum. Every young man, he avers, wants to wield the pick, and every young girl wants to put on jeans and get into the dirt. This is all well and good, but for financial and other cogent reasons, the center of emphasis in archaeology must shift from field work to the laboratory and the exhibition hall.

Such a manifest destiny is due in no small part to Nelson's own work. The fundamental principles that he has established enable the workers of the present day to tell pretty well in advance what they are going to get from a given locality. People in responsible positions need therefore assign only that work which is still to be done and thus guard against a duplication of essentially identical material from many different regions which would only add unnecessary weight to conclusions already well substantiated. It must not be supposed, however, that Nelson would have all excavation work cease immediately. He merely suggests that students reserve some of their ardor for the laboratory. And his view of this matter has doubtless been colored by the confused state of the collections bequeathed by his predecessors.

This might seem to bear out those critics of Museum activities who say that the institution is foundering in a welter of ineptitude. But the real difficulty is that there are not enough curators to cover all the exhibition halls. Nelson himself is responsible for all the archaeological halls in the American Museum except those of Latin America. And it simply takes his entire time to keep them up-to-date, a task at which he feels much like that denizen of Hades who kept pushing the rock up the hill only to have it roll down to the bottom again.

Nelson takes the public exhibitions of artifacts very seriously and earnestly strives to make everything as clear as possible to the general public. He is therefore gratified by the recent announcement that the Trustees of the Museum have put forward a program for modernizing the exhibition of material under his jurisdiction.

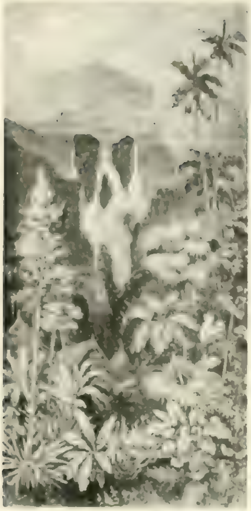
With such undertakings we may expect Nelson to become more and more identified in the future. Though he accepts this sedentary burden philosophically enough, he cannot help but cast a nostalgic eye over the trophies of his exploring days with which his office abounds, including an enlarged model of the Chinese junk on which he sailed up the Yangtze as Admiral Nelson.

But he is not the sort that thrives on memories. Let us hope, therefore, that some day—when he has gotten all his papers published and all his vast collections clarified for the use of specialists and public alike—Nelson will once again set forth for the diggings.

"No man," says Walter Granger, "ever had a better field companion than Nels. If I were going out on a desert island where I would have to be satisfied with the company of only one man, I'd choose him. Of all the camp mates I've had in 50 years of exploration, he is the only one who did not have some little trait or other which I knew would sooner or later rub me the wrong way. The most wonderful thing about him, I think, is that he knows when to talk and when to keep quiet, and that is an art few people ever learn."

No scientist could wish for higher tribute.

[illegible] Thus [illegible] [illegible] of Natural History [illegible]



Venezuela and British Guiana Boundary. The [illegible] pictured is so strikingly similar to the country photographed by Mr. Gilliard's party that the illustration could hardly be the product of poetic imagination. . . .

J. R. Mulryan.

Baguio, Philippine Islands

Mr. Gilliard, the author of the article, is convinced that the waterfall depicted is not Angel Falls but one in the region of Roraima, as specified, 120 miles away. It is interesting to note that even today, with the region fairly well mapped, no waterfall is generally recorded on the upper Caroni, but falls are numerous in the region and are [illegible] known by local names.—Ed.

Sirs:

I have just received the December number of Natural History. In the list of "[illegible] Highest Waterfalls" [illegible] mention any Iceland waterfalls, although there are several over 100 feet. I can mention that Dettifoss is 257 feet and very [illegible].

W[illegible]

Laxardal *via* Husavik, Iceland.

Natural History gratefully acknowledges the addition of this information to its catalogue of the world's waterfalls. Owing to the scarcity or inaccessibility of data in geographic literature as well as to restrictions of space, Natural History was [illegible] all the [illegible] [illegible] the world, [illegible] [illegible] the [illegible].—Ed.

[illegible]

Sirs:

I have long been accumulating a fund [illegible] has reached the bursting point with the [illegible] extremely interesting reading, and all beautifully illustrated. And especially the covers. [illegible] problem better than any other magazine I know about. They are all "natural history" and wonderfully arresting, as the tiger on the February issue, or beautiful as the one for March.

That March cover simply takes my breath away with its beauty. . . .

Mrs. H. W. [illegible]

[illegible], Mass.

(*Right*) The Indians are said to have marked their trails by bending saplings in the required direction. But this tree was not such a marker to indicate a right turn. In reality it is an ailanthus tree that has been assailed by a honeysuckle vine and has solved its dilemma in the Chinese manner—by "absorbing" the conqueror.

"Courting"—An unusual pose caught by Morris W. Wilsey of Oakland, California. Photograph taken at 1/50 second and f:11 with a K2 filter

NOTICE Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

NATURAL HISTORY

THE MAGAZINE OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XLVIII
June-December
1941

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NEW YORK, N. Y.

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June **NATURAL HISTORY** 1941

A Grand Canyon no one has seen · The Vanishing Caribs

A New Dinosaur · Mystery Monuments · Rubies & Pearls

LUME XLVIII, No. 1

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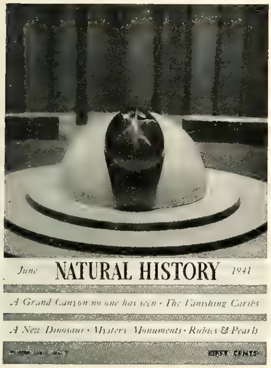
The American Museum of Natural History, 79th Street at Central Park West, New York, N. Y.

LETTERS

THE COVER THIS MONTH

The cover of this issue of Natural History bears a color photograph of the largest fine star ruby in the world. It is the 100-carat Edith Haggin de Long Star Ruby, one of the finest specimens in the gem collection of the American Museum.

The beautiful six-rayed star that glows within the gem is the result of a hexagonal pattern of fine tubular cavities within the ruby. These myriad tubules reflect the light from within when the stone is cut in the form of a dome.


June NATURAL HISTORY 1941
A Grand Canyon no one has seen · The Vanishing Caribs
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This striking color photograph is probably the finest reproduction of a star ruby that has ever been achieved. The gem is on display in the Gem Hall of the American Museum, where it resides in the dramatic setting designed by William Bayard Okie, Jr.

* * *

Sirs:

The Natural History Magazine covers are most attractive. Is it possible to obtain cardboard replicas such as are displayed on newsstands to advertise the magazines?

I am a Life Member and a teacher in the elementary schools of New York. Many of your covers can be used in Nature lessons. But I do not like to deface the magazine by removing the cover. I shall be glad to come for the pictures if any are available.

May's cedar waxwings are delightful, and April's blossoms were beautiful. I should like those very much for the schoolroom.

(Mrs. Myrwin L.) Mildred Eaton.
New York, N. Y.

Natural History Magazine's full color covers are available not on cardboard but on the same heavy paper that is used on the Magazine at a cost of 5¢ each, plus a charge of 5¢ for postage on any order up to ten copies. —Ed.

Sirs:

I am very sorry to have to inform you that when my current subscription runs out for your most enjoyable and informative magazine, I shall not be able to renew it.

Owing to exchange difficulties, it is now illegal for money to be sent out of Australia except for sustenance, and although I tried to plead that my "mental sustenance" was helped by your publication, I was not permitted to apply for a money order for this purpose. . . .

I have always enjoyed reading Natural History, and when I have finished each number I send it over to friends in Taupo, New Zealand, where it is passed round the district and brings much pleasure. . . .

Esther Buck.
Newcastle Girls' High School,
Hamilton, Australia

* * *

Sirs:

As a source of supplementary material for informal talks and class discussions, Natural History's educational value is inestimable. Its wide range of subjects in its own field appeals greatly to the boys here, who find it not only informative but extremely interesting. I sometimes wonder what we would do without it.

Your pictures are splendid, if not the best, but for readers who may be interested in photography may I suggest that more photographic data be given whenever such is available.

Roderick Hagenbuckle.
The Fessenden School,
West Newton, Mass.

* * *

Sirs:

In a recent discussion of the homing instinct of various animals, mention was made of experiments with a toad. The experiments were made somewhere in the vicinity of Boston.

I wonder if you could give me some further information concerning these experiments or suggest some publication containing the information?

Fred S. Johnson.
The Bowery Savings Bank,
New York, N. Y.

Mr. C. M. Bogert, of the Department of Herpetology in the American Museum, gives the following brief summary of what is known:

Most of the information regarding am-

IMPORTANT NOTICE TO MEMBERS

NATURAL HISTORY is not published during July and August. Those members, however, who wish to have their September issue sent to a temporary summer address are requested to notify the Membership Secretary, giving the date at which they will return to their permanent address.

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[illegible]

[illegible] The following afternoon, and hardly 20 [illegible] does not corroborate this story. In his study [illegible] in 1937 reported that of 570 toads tagged [illegible] traveled by any toad in returning to the exact point of capture was 725 yards. Another toad recovered "toward the point of capture" had traveled 1150 yards. The maximum speed Nichols recorded in toads returning to the point of capture was less than one-tenth of a mile an hour, hardly [illegible] a mile an hour purportedly averaged by the single toad liberated near Boston. Of 141 toads that Nichols removed one mile or less from the point of capture, he was able by intensive work, to recover only 63, and of this number only 30 were at the [illegible] quarter hours to 24 days after their release.

The toads which Mr. Nichols was dealing [illegible] *fowleri*, the species most likely to be found in gardens of the Boston suburbs. The logical assumption is that the scientific work is the more reliable, and that the popular [illegible] far as the accuracy of the toad's traveling ten miles in less than 20 hours is concerned.

However, there is every reason to believe that the homing ability in certain amphibians is fairly well developed, particularly in the tailless forms. Under normal conditions many toads regularly return to the same shelter night after night, after spending the evening foraging for insects. During the breeding season many species of frogs will come forth from their retreats at night and return to exactly the same calling station. I found this to be true of a dozen American bullfrogs that I had introduced one spring at a small lake on the edge of the Mojave Desert, far from their normal habitat. This lake had previously [illegible] but within a week after I had introduced the bullfrogs, each of about 10 large males had taken up positions at definite localities along the edge of the lake. On subsequent week ends when I visited the place, I invariably found frogs calling at precisely the same places.

In Panama, Dr. C. M. Breder, Jr. discovered that male tree frogs (*Hyla rosenbergi*), which construct mud basins for the rearing of tadpoles, returned on successive evenings to the same basins. Doctor Breder, with Mrs. Breder and Redmond, also published reports on experiments that were conducted in Palisades Interstate Park and near Haskell, New Jersey. Here [illegible] one-quarter of a mile in less than 24 hours over very difficult paths and surmount numerous obstacles to return to their 'home' territory." Two out of three green frogs released several hundred feet away from their home springs returned even [illegible] where equally suitable habitats existed and where other green frogs were dwelling. It is possible in this instance that other male frogs had already assumed "control" of the suitable stations and did not permit intruders to remain in their territory.

Just how these animals manage to return to their home stations is not known. Some investigators have concluded that amphibians rely upon a number of visual impressions and that new scenes are avoided because they "arouse discordant feelings." Work done by Doctor Yerkes nearly 40 years ago suggests that vision plays some important role in the homing ability of frogs, even though much remains to be explained. Yerkes found that green frogs learned their way through mazes without much difficulty. In an effort to find out what cues were being used he arranged a maze with the walls of one alley red and the other white. After the maze had been learned by frogs, he reversed the colors, and found that frogs were obviously confused. They selected the blind alley instead of the outlet although on previous trials they had learned the maze so well that no mistakes had been made.

Salamanders, oddly enough, seem to show little homing behavior and usually do not return to the same retreats. But they are, nevertheless, able to learn their way through mazes.

Considerable interest has lately been centered on homing behavior, and I imagine some interesting facts will be brought to light. The fact that rattlers as well as some other snakes congregate in winter "dens" in the colder portions of the United States suggests that they possess some ability to find their way to their home dens. The researches of Dr. A. M. Woodbury of the University of Utah have lately shown that desert tortoises also congregate in winter dens but disperse during the summer to establish individual burrows that serve as bases for their activities. The movements of birds have long been studied by attaching identifying tags to individuals, and now similar methods are being used in studying the movements of many other vertebrates, from fish to mammals. Doctor Woodbury has found it possible to tattoo identifying marks on the bellies of snakes; but in most of the frog experiments cited above tags of various sorts were attached to the animals so that there was never any question concerning the movements of individuals. Usually nearly half of the individuals tagged were recovered in the case of amphibians, but with other groups of vertebrates, recaptures have not been so successful.

This will give you some notion of what is known concerning the homing ability of toads, and certainly some of the evidence is very convincing. However, we still doubt that the toad traveled ten miles in less than 20 hours through the streets of Boston. We do not like to spoil a good story, but the substantiated facts are interesting enough, and I look forward to seeing more experimental work done with the homing of amphibians.

· · ·

Sir:

. . . I seldom write letters of comment but I do wish at this time to express my great enjoyment of your magazine. In these times of strain and worry many of us are all too apt to forget to take comfort and refuge in more lasting and dependable interests. Also, city dwellers . . . cannot always get away, physically or mentally, [illegible]

We have to plan our vacations very carefully and we have followed up very happily several ideas suggested by NATURAL HISTORY. The most interesting experience was one of our most exciting adventures. Several years ago, following an article on the ice caves in Grant, New Mexico, we set out on a side trip to see the one described. We found it after a good deal of difficulty, and . . . wound up on the Cibola National Forest lookout, and were charmingly entertained . . . by the Ranger, his wife, and three sons. Our objective that night had been the Continental Divide, and it happened that our tent had been pitched squarely across it. . . .

We were so glad the article made the side trip sound more practical than it really was. We didn't really have time to do it but wouldn't have missed it for anything.

(MRS. C. W.) HELEN TALBOT CORELL,
New York, N. Y.

· · ·

Sir:

I have duly received the first number . . . and I am glad to congratulate you on this publication, very fine and useful to me and to the world of naturalists . . .

A. L. HERRERA

Sociedad internacional de Plasmogenia,
Mexico City, Mexico

· · ·

Sir:

You may be interested to know that for years our copies of NATURAL HISTORY have been traveling to the ends of the earth, and in instances they have gone to places where they and other items in the bundle were the only reading matter in English. For some time the Magazine has been forwarded to a friend in Australia who gives two afternoons a week to read to the men blinded in the first world war. And since the present war started, her son-in-law has been with the troops, so that NATURAL HISTORY goes to Australia, is quickly read there, and then is sent (by Air Mail) on to Dick—who was for months in Palestine, and later in Egypt with Wavell. I wish one copy could write back and report on its travels.

So I send my deep appreciation of a fine task done so well that it inspires those who see and hear and read.

MRS. [illegible]
New York, N. Y.

· · ·

Sir:

. . . complimenting you for the fine magazine you publish . . .

MORTON KLEIN.

Brownsville, Pa.

NATURAL SCIENCE SPEAKS TO MAN

Linnaeus, in his *Systema Naturae* (1759), classified all the then known species of animals, plants, and minerals. Just below the angels and at the head of terrestrial creatures Linnaeus placed the Primates (Latin, *chiefs*), beginning with *Homo sapiens* (man) and passing downward through the various species of Simia (apes and monkeys) to the lemurs and the bats.

Eighteenth century man could not accept this ruling without protest. Gratified at being placed next to the angels, he could not endure the idea of being bracketed with monkeys. Writes Thomas Pennant (1781), "I reject his division—because my vanity will not suffer me to rank mankind with Apes, Monkeys and Bats."

Charles Darwin (1871) suggests that, "as man from a genealogical point of view belongs to the Catarrhine or Old World stock [of monkeys and apes], we must conclude, however much the conclusion may revolt our pride, that our progenitors would have been properly thus designated."

Man's origin, going back millions of years to the earliest backboned animals, is today accepted by all natural scientists, yet great numbers of people still refuse to accept such lowly relationship, and even scientists like Pennant and the great Darwin at one time were gravely disturbed.

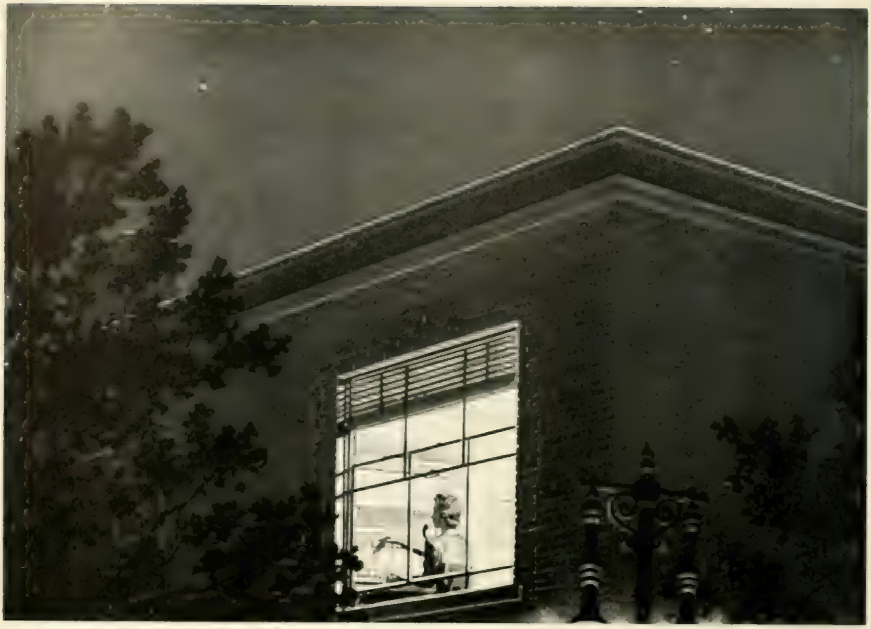
As the Natural Scientist sees it, man lives in two worlds, the natural world and his own man-made world. In the latter, man is confused by a babel of different languages, mutually conflicting tribal traditions, superstitions, codes and cults; and long records of history, knowledge, and thought only seem to add to his confusion. But although man is apt to think he lives exclusively in his man-made world, the urges or instincts which drive him to action come from his natural world. And it is the service of Natural Science to bid man remember that he is but mortal and that it behooves him to walk humbly, not with vanity or pride.

Natural Science says to man, "Before considering action in your man-made world, know yourself and your place in the world of nature. Since you have been endowed with the priceless freedom of choice, you, alone of the animal world, may deal with your age-old natural urges or instincts. Choose between two instincts if you will—either co-operation with your fellow creatures or force urged by self-aggrandizement and fostered by pride and vanity. Both instincts are of ancient origin in your animal make-up but lead to basically different results. Co-operation, the instinct of the family, herd, and flock, you have never chosen and adhered to on the grand scale. It might bring your man-made world to an enduring brotherhood—enduring, biologically, because co-operation should encourage self-development. Force, self-aggrandizement and individual advantage you have often tried and so set up your many man-made worlds headed by the Caesars of history. These worlds have always perished and, although climate and disease have played a part, the destruction of such worlds is in the main caused by the decadence of inhabitants who have lost their freedom and consequently their initiative and virility. Why not try co-operation?"

A Perry Osborn

First Vice-president of the Board of Trustees,
The American Museum of Natural History

For further reading along these lines, see W. K. Gregory's "The Orders of Mammals," *Bulletin of the American Museum of Natural History*, XXVII (February, 1910); and "Nature's Upstart: *Homo Sapiens*," *The Teaching Biologist*, V, No. 2 (November, 1935); also M. D. Stevers' *Mind through the Ages* (Doubleday Doran, 1940)



"I judge the telephone company by the people who work for it"

A little while ago a Vermont newspaper editor, John Hooper, commented on the telephone company and its people. His words express so well the ideals toward which we are striving that we quote them here.

"I don't know how big the telephone company is, but it is big enough to exceed my mental grasp of business.

"But I don't find myself thinking of it as a business, even in my day-to-day contacts. Rather, my attention is on the voice that says, 'Number, please.' I find myself wondering if that voice is feeling as well as it always seems to, or if it feels just as hot and weary as I do, and would say so if it wasn't the kind of voice it is.

"The first time the business angle really struck home was when I read that my friend Carl had completed thirty years with the company.

"Now it happens that I know something of the details of those thirty years with the company, and I believe they are a credit both to Carl and to the big business for which he works.

"In 1907 Carl was a high school boy confronted with the need for earning money in his spare time. He happened to get a job as Saturday night operator in the telephone exchange. He worked at this job for three years and then entered the university.

"While in college he did some substituting at the exchange in his home town in vacations. After graduation, he was hired full time by the telephone company, not in an 'executive' position which some folks think goes with a college diploma, but as a lineman.

"Within a year he was made wire chief of the district, a job which he held for the next ten years. He was then transferred to a larger city as manager of the office. Then he was promoted to sales manager of the division.

"A year later he was sent to another State, as district manager. In less than a year after this appointment, he was made manager for the entire State.

"I don't know much about the telephone company as a business; I can only judge it by the people who work for it. Just where the dividing line is between a business and the people who work for it, I don't know. I don't think there is any line."

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, Sc.D., Director

VOLUME XLVIII—No. 1 ★ ★ ★ ★ ★ ★ ★ **JUNE, 1941**

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I'LL TAKE

THE HIGH ROAD

Here are two roads to nature. One of them lets the wilderness alone, enables the nature lover to smell it, feel it at leisure, soak it in through all his senses. The other?—Well, take your pick

By DAVID LAVENDER

PROBABLY no one is recipient of more unwanted favors than is the poor nature lover. Every Chamber of Commerce that dreams of increasing automobile traffic in its area takes him to its ample bosom. Contractors who can't tell a goldfinch from a trailing arbutus; bond salesmen and purveyors of road machinery; manufacturers of cement and drain pipes; labor leaders and advertising writers—all these and others are his most solicitous friends. He likes nature, doesn't he? Then build him new roads so he can see new sights. What could be more generous?

It is, of course, impolite to bite the hand that feeds one. Besides, the amateur naturalist is an inarticulate sort of fellow whose main desire is the undramatic one of being left alone. Rather than kick up a fuss by appearing ungrateful, he quietly moves out of each new region his friends open up for him and goes on to the next hill or valley.

But more and more he is wondering how long his few remaining hills and valleys can hold out. The wilderness—the inexhaustible American wilderness—is dying before his eyes.

This has been said many times,—so many that it has brought forth rebuttal. I read not long ago statistics that showed conclusively that half of the United States is uninhabited and almost certain to remain so. The author pointed to the Florida Everglades, the great deserts of the Southwest, and the rearing Sierras of California; to the vast gorges of northern Idaho, the trackless bayous of Louisiana, and the spreading pine forests of eastern Texas; to the state of Nevada with a population less than that of Trenton, New Jersey; even to the rocky, grudging hills of New England. He proved, in short, that nearly every state embraces certain profitless localities which can never be settled by more than a few strange outlanders,—and these outlanders add to the region's picturesqueness.

He is doubtless right,—so far as *settling* goes. But he forgets the automobile. Drag a scar of asphalt along the lovely flank of any wilderness, and instantly it ceases to be a wilderness, though not a single "permanent" settler is added to the census taker's list.

Even this is pooh-poohed as an alarmist's point of view. I was grumbling recently to a representative of an automobile club about an improved highway that is slowly being pushed into the Navaho country of northern Arizona. It seemed a wanton thing to me. In the colored desert surrounding Kayenta and in the shadows of the stark red buttes of Monument Valley is one of the last places where the Navaho can live as he used to live, speaking little or no English, content with his hogan of brush or mud, unashamed of his straight, uncut hair done up in a gaudy calico band. Around Shiprock and Gallup, or wherever the main highways run, the Navaho has cut off his hair and aped other "civilized" ways, not always to his benefit. It struck me as a pity, I ventured, that these people could not be allowed one spot where they might cling to the heritages of a past far older than our own.

"Pooh," the auto man said. "One road isn't going to change this whole reservation. The country's so big, and it would cost so much to reach all the back regions that some of your wild men probably never will see an automobile unless they come in to the central trading posts."

Photo by E. W. Van Wagenen from Black Star

IN NATURAL WONDERS easily accessible to the summer tourist, North America has a heritage of unrivaled diversity and beauty.

In California alone one could spend two weeks every summer touring only on National Forest and National Park highways and never see them all in 28 years

YET with all this natural beauty for the asking, private interests increase the pressure for roads where none are needed and lace up our scenic outdoors with a network that brings destruction to almost every form of natural beauty. It is time to stop the billboard panorama [illegible] road [illegible] the San Miguel Mountains [illegible] Colorado [illegible] grazed out. Today the vast herds of cattle they brought in are gone. Arroyos yawn where storm waters roar off the denuded hills. Ranches have [illegible] barbwire fences. Those men have learned that nothing [illegible].

I [illegible] draw, on every brushy mesa. They, too, are gone. But there is a road. I remember when it was built and the first gunners it brought. And when I think of that I can't help recalling the cold mountain dawns when my brother and I would pile shivering out of bed to meet each new morning with a boy's unquestioning delight.

It was our job to bring in the horse herd. Off we went riding double on a barebacked old "night" horse we had kept tied in the barn. I can still smell the hay on his frosty breath, still feel his warm hide between my dangling legs. The long grass glittered with dew. The rising sun washed the peaks with a golden light that threw each timbered fold into sharp relief.

Suddenly a soft, muttered clucking off in the sagebrush would bring us out of our dreams. We would slide off the horse and creep forward, taut with excitement. When the old cock guarding the covey craned his mottled neck over the scrub, we were ready. *Whir-r!*—we could really peg rocks in those days! Then, after we'd brought the horses thundering into the corral, we would clean our prize and race into the cabin to watch mother fry him in a pan of hot bacon grease. The smell of him was even better than the eating.

Sometimes—high moment!—my stepfather would take down his beloved shotgun and whistle for his two black-eared setters. The dogs were a luxury there where you could flush a multitude of birds in any half-hour walk. But he liked to see them coursing the fields or freezing to stiff, eager point.

Like our neighbors he never killed more than we could use and only when fancy dictated. Consequently we couldn't understand it when, shortly after the new road between Norwood and Dolores was opened, two gunners stopped by and in a single afternoon killed 175 prairie chickens. I am sure of the figure. I saw the back of the car piled high with their slaughter. And I read the account of the trip they wrote up for their home town paper. One hundred and seventy-five in one afternoon. They mentioned the number several times, as though they were proud of it.

Until that day I had thought that gunners were sportsmen. Certainly the ones were who took the trouble to get into our back country before the advent of the road. They liked the beauty of the land as much as its hunting. They respected our grain fields and grazing stock. Above all, they respected the game.

Spoliation

The new road brought in an entirely different kind of being: a man who, if he saw the dawn or violet dusk at all, saw it through a windshield at 50 miles an hour; who kicked down fences, trampled grain and was in such a hurry to kill that he left the trouble of finding his crippled birds to the coyotes. He was the game hog and, game laws notwithstanding, he appears on each new wilderness road as surely as does the billboard.*

A wilderness area in the United States long ago ceased to mean a region awaiting exploration or development. Its connotation now is of a spot noteworthy either for scenery or game and sufficiently remote from roads to require the average camper's staying at least overnight in a bivouac of his own making.

In a country half uninhabited such areas are surprisingly few and far between.

For example, in all California, second largest state of the Union, there are only seven wilderness sections a man can't hike across in a short day. Of these seven, only two are more than ten miles from the end of some existing automobile road. One of them is, of course, truly vast: the famous High Sierra region, some 2,300,000 acres in extent.

Two other sections, surpassing even the Sierras in size, stand out in the wilderness lover's mind. One is the grotesquely carved, highly colored land that lies along both rims of the Colorado River from eastern Utah south into Arizona, a territory of 10,000 square miles more or less (depending on how far up the many tributary canyons its boundaries are conceived to extend). The other is the thundering gorge of the Salmon River in north central Idaho, the largest tract of untrammeled game country left in the United States.

Formidable lands, these three, offering almost nothing in the way of economic exploitation. Yet look what is happening to them.

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* [illegible]

It is now officially proposed that a National Monument be created in Utah, starting near the Arizona boundary and embracing both banks of the Colorado as far as Arches Monument, near Moab, and including also the Colorado's main tributary, the Green, as far north as the town of Green River.

Today a single highway barely nicks the eastern edge of this enormous territory. It is a one-way dirt road, passable only in summer, and leads to Edwin, or Owochomo, Natural Bridge at the head of White Canyon. This road, it is argued, should be made into an all-weather highway and extended on down White Canyon to the Colorado, across the river and out the other side, thus splitting the region in half. Eventually, if the proponents of the Monument have their way, other roads will scar both rims of the Colorado, but as a starter they are willing to settle for the first one mentioned.

Not even the most rabid booster of the project pretends that this costly highway will benefit the region itself. The entire population of 200 or 300 miles of the canyon bottom could be taken out in a single car. One lone cattle company grazes stock along the rugged east breaks, and its owners have declared themselves unalterably opposed to the road. But the boosters are not dismayed. They still have, as an argument in favor, their old standby, the nature lover. Just think of the scenery it would open up for him!

"What scenery?" one timidly asks. The deep, colorful gorge of the Colorado? It is deeper and more colorful where roads already exist: in Grand Canyon National Park. The breathless precipices and templed rocks of its great buttes? There are greater buttes in Zion Park. The fantastic erosions of wind and water? Bryce Canyon is more fantastic.

The same threat is even more real for the Salmon River in north central Idaho, Paradise of hunter and fisherman. Already a road has reached down the mainstream from the town of Salmon to the Middle Fork. The CCC, those unflagging zealots of the road-building fraternity, are blasting upstream from the town of Riggins. Now only a hundred miles separate the converging road ends, and two local Chambers of Commerce are whooping it up for quick completion. And what is to pay the enormous cost of constructing and maintaining this highway? Why, a tiny one-family mine here and there, a couple of hat-sized patches of arable land,—and the grateful nature lovers who will flock in with open purses.

One wonders how grateful the nature lovers will really be. In the minds of hunters, campers and fishermen everywhere the Salmon is, above all else, "The River Of No Return." It is so called because, though it is possible for the venturesome to go downstream by boat—"the wildest boat ride in America,"—no one has yet been able to return upstream. The road will end all that. And more. It will end fishing and hunting—steelhead, salmon, trout; deer, wildcats, bear, mountain sheep and goats,—unrivaled anywhere else in the United States.

If you doubt the desecration of roads, look what has happened to some of the tributaries of the Salmon. At Bear Creek, for example, you once could tumble out of your sleeping bag and in half an hour catch all the fish you wanted for breakfast. Now you'll cast all day for a measly mess of six-inch trout. The man who lands one of the salmon for which the watershed was named makes news.

After all this it would be repetitious to tell about the road which the State of California has gouged into Kings River Canyon, the very heart of the High Sierra wilderness; of another that is in the planning stage and will cut the body of this wilderness in two, crossing the entire range from Porterville to Lone Pine and "opening up" the Kern River region.

The motorist already has available to him the lion's share of the finest mountain scenery in the United States: in Glacier, Ranier, Rocky Mountain, Yellowstone, Yosemite, and Sequoia National Parks, —to say nothing of tens of thousands of highway miles which, though not built primarily for scenic attractions, nonetheless afford plenty of them. In California alone, he can drive more than 100,000 miles. The average man, on an average two weeks' vacation trip, could not see all California's roads in a hundred years. He would use up 28 years of vacations just touring that state's National Forest and National Park highways alone.

Meanwhile, bottlenecks and bad crossings

Highway engineers say that before a modern road can pay for itself it must carry 400 cars a day every day of the year. The average purely "recreational" road draws less than 100 a day. And still the pressure is on for more, although California's highway department repeatedly points out that all available funds are necessary to maintain and improve existing roads. Meanwhile traffic arteries, which serve a definite economic function, remain full of bottlenecks, dangerous curves, and railroad crossings.

It is impossible for the true wilderness lover to see the country from a speeding automobile. He has got to absorb it leisurely, sleep right down on the ground, smell it, feel it, soak it in through all his senses. "Improvement" on nature is, to him, incredible,—yet hand in hand with road building has gone improvement. Underbrush has been cleared out and burned, killing nesting birds and making room for [illegible] Appalachian Trail in the Great Smokies. It would be interesting to know, now that the publicity attendant on that [illegible] people use the trail than before. Isn't it possible that [illegible] because it was a natural, "unimproved" pathway?

It is said that this clean-up campaign is a fire [illegible] need the cover and food provided by an abundance of undergrowth and down timber? What of the violets that bloomed by that mossy log? The azaleas that rioted in the thicket?

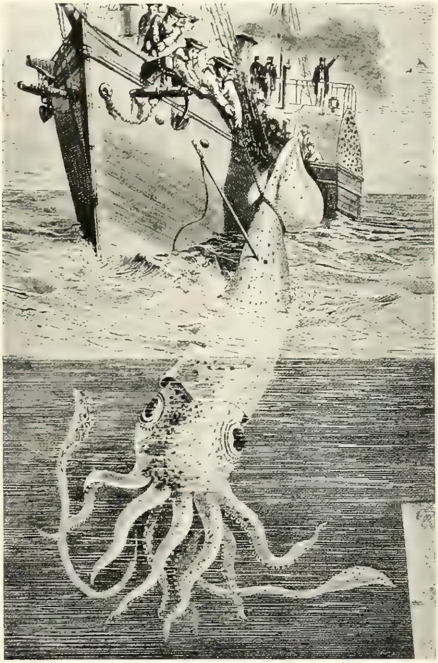
[illegible] recluse. Last summer nearly 140,000 people went into Colorado's wilderness areas alone. They did it in what the motorist would call "the hard way." They walked or rode horseback. They carried their supplies on their own backs or packed them on mules. They cooked their own food, made their own beds, cleaned up their own mess. And they did it because they liked it. Because there seems to be in some men and women an inherent craving for pioneering, for outdoor "adventure." Because they can find in the [illegible] untracked streams a few simple values for living that are overlooked in the rush of the cities.

More roads will bring the motorist nothing that is not already available to him over and over again. But to the wilderness lover they will bring more fires, more erosion, fewer trees, smaller streams, less fish and game.

Isn't it time we stopped giving the poor fellow so much?

SCYLLA WAS A SQUID

By W. Ley



Nearly all mythical monsters have a basis in fact. The creature at right is the artist's conception, but the inspiration is obviously the giant squid. This drawing depicts the encounter of the *Alecton* with a giant squid, in 1861

Illustrations from Monsters of the Sea, by John Gibson, 1887

Charybdis may have been a whirlpool, but modern science now recognizes the other half of Homer's legendary partnership in maritime disaster as possibly the first mention in literature of the giant squid

It was on the last day of November, 1861, that the lookout man on duty on the French corvette *Alecton* announced: "a large body, partly submerged, on the surface." The vessel's position was about 120 miles northeast of Tenerife, the largest of the Canary Islands; the sea was calm in the oppressive heat of a clear sky, and the commander of the corvette decided that the object should be approached and investigated. It turned out to be a gigantic squid of a bright brick-red color, with immense black eyes that were not easy to look at. The body of the monster was about eighteen feet long, the tentacles at least another eighteen feet and the weight was estimated to be about two tons. The squid was drifting lazily at the surface but was unmistakably alive.

The commander of the *Alecton* knew that the existence of such gigantic squids was still disputed, although only recently a few dead and mutilated monsters of that or a very similar type had been washed ashore, one off Zeeland, Denmark, in 1847 and another at the Skaw in the same region in 1854. This encounter with a live animal afforded an excellent opportunity to settle that disputed question once and for all and to furnish a belated vindication for the commander's compatriot, Denys-Monfort, who had published a complete collection of all reports referring to such animals in his *Histoire naturelle . . . des Mollusques* in 1802 without earning anything but ridicule for all his work.

Since the *Alecton* was a war vessel, there was no lack of armament. Cannon balls were shot at and through the lazy kraken (to use the old Scandinavian word for the fabulous sea monster); and harpoons were thrown at it. But it seemed as if no projectile

[illegible]

After three hours of intensive naval warfare, the squid suddenly vomited (one of the cannon balls [illegible] around the body. The rope slid along the slippery sides and finally caught at the large rear fins. The men tried to haul the gigantic cuttlefish aboard, but its weight was so great that the rope cut through the body, severing the hind part. This part was salvaged but had to be thrown away soon after. Thus the [illegible] and crew brought an exciting tale to tell.

[illegible] not generally recognized at that time. (They came to [illegible] than a dozen of the monstrous creatures were washed ashore at Newfoundland, some of them still living.) Therefore some armchair explorers quickly and gravely informed the captain and ship's company that they must have been the victims of a mass halluci[illegible]

To those who put that interpretation on the adventure it sounded perfect. But to the men who had worked for hours under a tropical sun to secure a heavy and repulsive specimen, being in various kinds of danger all the time, that explanation did not seem so correct. It is regrettable that history has the habit of recording only the sayings of politicians and diplomats,—the remarks the French sailors made when suspected of mass hallucination were never printed.

Before those gigantic squids were seen and examined by zoologists,—the one that was battled by the *Alecton* is by no means the largest on record—, knowledge about the existence of such animals rested mainly with the writings of two Scandinavian authors, both of them famous, both immensely learned, but both also given to exaggeration and a peculiar credulity. The older of them is Olaus Magnus, "Archbishop of Upsal and Primate of Sweden," who delivered a vivid description of the kraken (the common use of this Norse term goes directly back to [illegible] *tions*. He said that the kraken had "long horns round about like a Tree rooted up by the Roots." And he did not forget to mention the large eyes, telling that they "are red and fiery colored and in the dark night [illegible] ing fire."

[illegible] the kraken in the second volume of his weighty *Natural History of Norway*. The book was written in 1753, and an English edition appeared in London in [illegible] modern," consulted by Pontoppidan, "seemed to have much knowledge of this animal," he had to rely on tales of Norse fishermen and on their folklore. The tales were sensible, as we now know. One of them relates that a kraken, "perhaps a young and careless one," was caught between cliffs and trees near Alstahong in 1680 and died when the tide receded. The [illegible] a mile in circumference, appearing above the waters like a group of small islands.

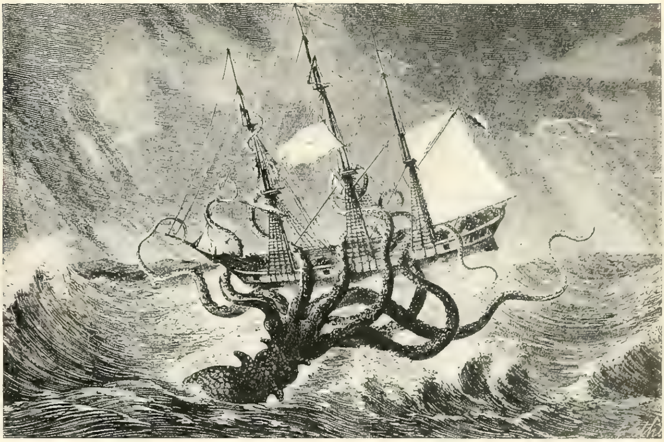
It was because of this story that the existence of giant squids was doubted and ridiculed for more than a century after the first printing of Bishop Pontoppidan's book.

[illegible]

It is, incidentally, not true that the works of the classic authors do not contain references to the existence of gigantic squids. The best known reference in classical times (and probably the most reliable one) is that in the *Historia Naturalis* of Gaius Plinius Secundus, better known as Pliny the Elder. He reported that "more than a century ago" (which would be around, say, 100 B.C.) a gigantic cuttlefish was caught in the strait between the Pillars of Hercules (Gibraltar). Its head was "as large as a keg holding fifteen amphorae of wine, and the arms were 30 feet long and so thick that a man had difficulties to reach around them."

But even that is not the oldest literary mention of a giant squid. There exists one of much greater age, and it can be found in one of the most famous books of the world's literature, in Homer's *Odyssey*. It is certain that this poem did not undergo even small [illegible] though Homer is usually thought to be an approximate contemporary of Hesiod, which means that he probably lived around 750 B.C. Now it is rather unimportant whether Homer is to be regarded as an historic person or not, or whether he is thought to be the author of the *Odyssey* or only the compiler of older material. The wording of the poem is at least 2500 years old, the material two or three centuries older; and no matter who wrote certain passages, they convey to us what was known or at least believed 2500 years ago.

The mention of a giant squid occurs in the Twelfth Song, where Circe describes to her hero the dangers of Scylla and Charybdis. Again, it is of little importance in this connection whether Scylla and Charybdis



ANOTHER example of reasonable accuracy in fanciful art. The giant squid became generally recognized as a real animal in the 1870's

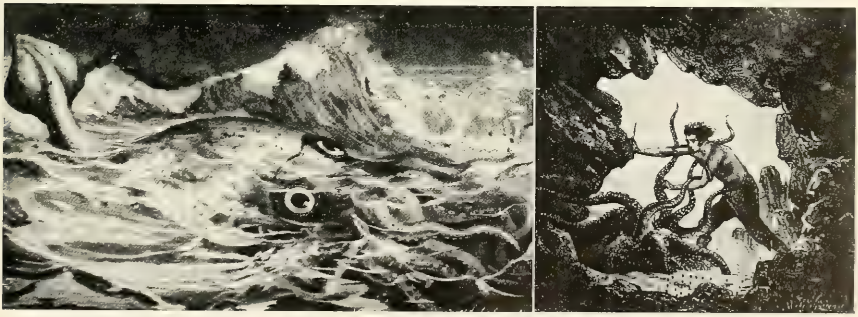
are thought to refer to the Strait of Messina beween Sicily and Italy or to the Strait of Gibraltar. The older school of thought asserted that the Greeks of that period did not sail the Mediterranean farther west than to Sicily, while more recent commentators point out that more extensive geographical knowledge may be embodied in the poem.

But there can be no mistaking the identity of the creature called Scylla. Circe's careful description of it could only be misinterpreted at a time when the existence of giant squids was denied. In speaking of Scylla, Circe says:

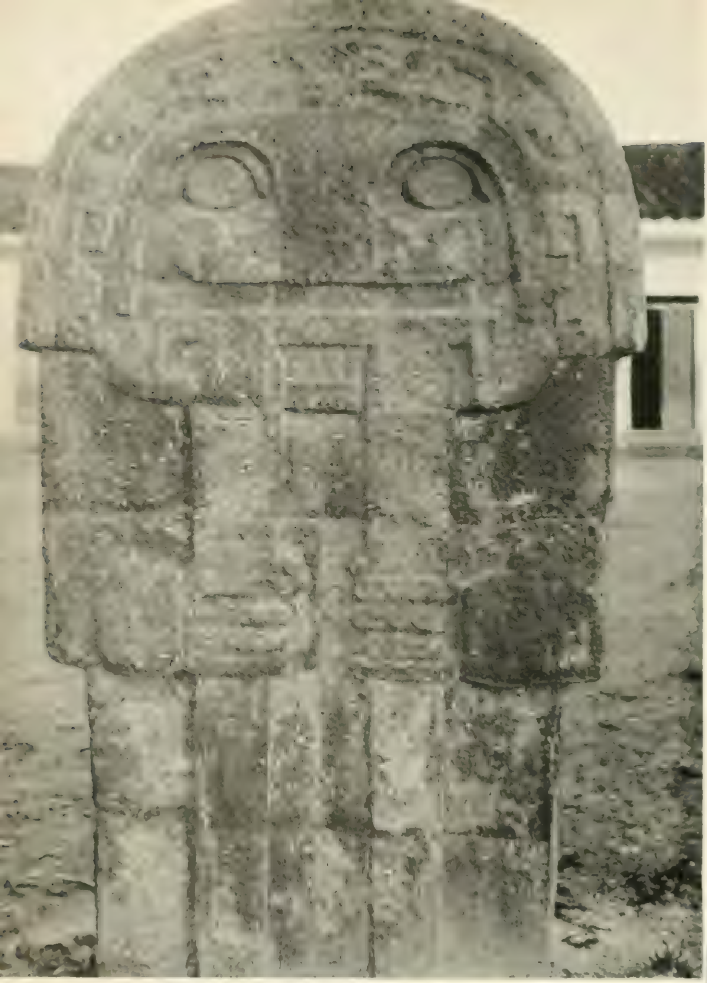
> . . . but her form is a sight portentous that no one
> E'er would gladly behold, not even a god if he met her
> Round her a dozen of feet she is always waving suspended
> Six long sinuous necks outstretching before her and each one
> Beareth a head terrific with teeth in a threefold order
> Many and thickly arrayed, where gapes death's cavernous blackness.
> Up to the midmost part she is hid in the depth of the cavern
> Whilst from her lair in the fearful abyss six heads she extendeth
> Hunting for fish at the foot of the rock and peering around it,
> Dolphins to catch or dogfish, or haply another and greater
> Beast . . . (*Odyssey* XII, 96)

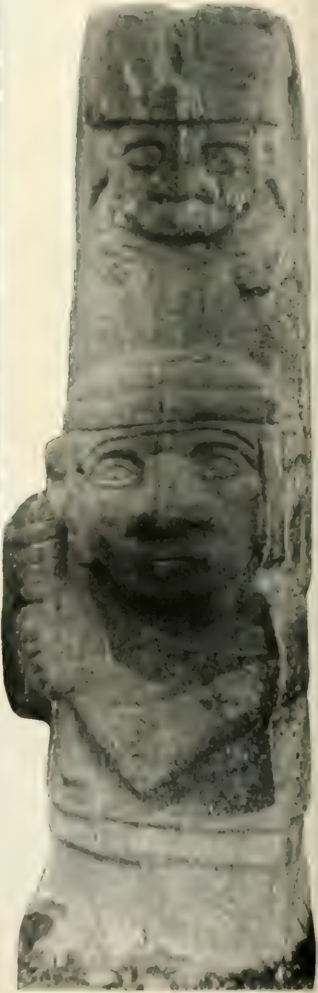
It is to be assumed that the Phoenicians experienced an adventure with a gigantic squid about which they told widely and often, possibly with the added purpose to frighten sailors of other nations away from that dangerous spot,—which happened to be on a very lucrative trade route. Needless to say, the description does not satisfy our present-day ideas of zoological accuracy,—an octopus, as the name implies, has eight arms, and a squid ten. But a couple of tentacles more or less would not be a matter of crucial importance in Homer's day, especially to a dismayed sailor. And terrible Scylla, with her dozen feet always waving suspended, could scarcely be other than one of these gigantic invertebrates. The "mythical" animal that has become immortal in literature had "teeth in threefold order," which are surely the lines of sucking disks; and if the locality in question is actually the Strait of Gibraltar it is a section where giant octopuses were encountered again and again from the times of Pliny until recently.

IN EARLY times the huge, tentacle-wielding cuttlefish, or calamary, was often confused with the octopus *(below)*



By Luis A. Sarmiento





(Above) An ancient statue called "The Sun," which ornaments the square of San Agustin at the headwaters of the mighty Magdalena

Though the ruins of San Agustin lie far in the interior of Colombia, swift modern means of travel enable one to enjoy their peaceful atmosphere of antiquity within four days after leaving New York

(Right) Whatever wars may have troubled the ancient people, this warrior now looks out on the placid plaza of San Agustin, in quiet farmland

THE UNKNOWN AGE IN COLOMBIA

One of the most impressive prehistoric sites in the Western Hemisphere holds the mystery of a vanished people, which will be solved when archaeologists fully explore it

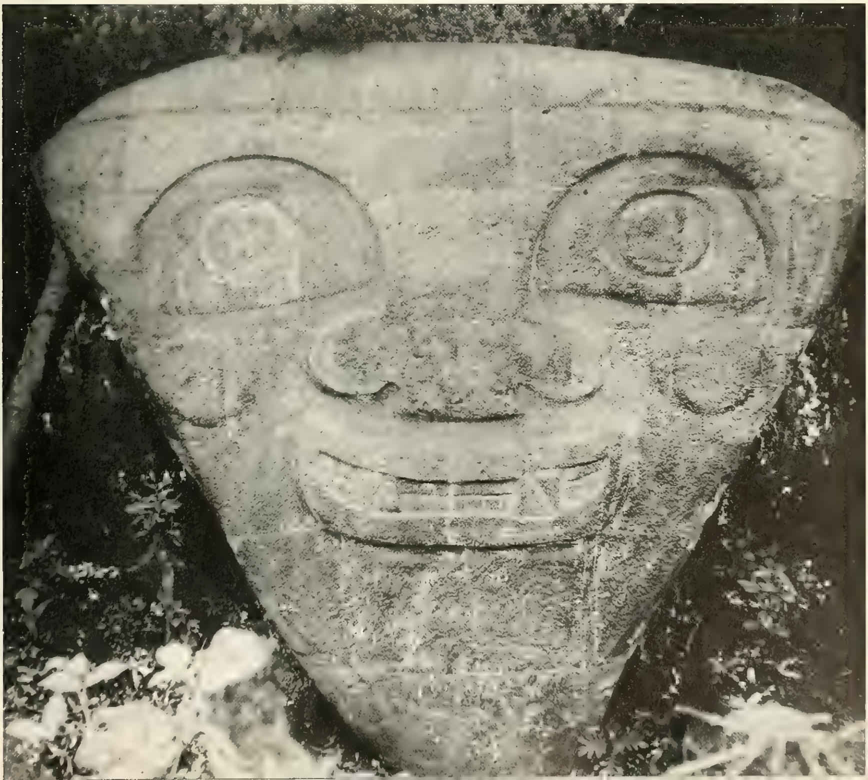
It is from the capital city, Bogotá, that we make our excursion to the ancient ruins of San Agustín. At Bogotá we are near the very center of Colombia, the first of the South American countries one reaches coming from the north, just south of the Panama Canal. We are among clouds which bring thunder and hail, 8660 feet above sea level on Colombia's eastern plateau. But the climate is perpetual spring, similar to that of New York in April. It is a static climate. The government is static too, neither revolutions nor unrest.

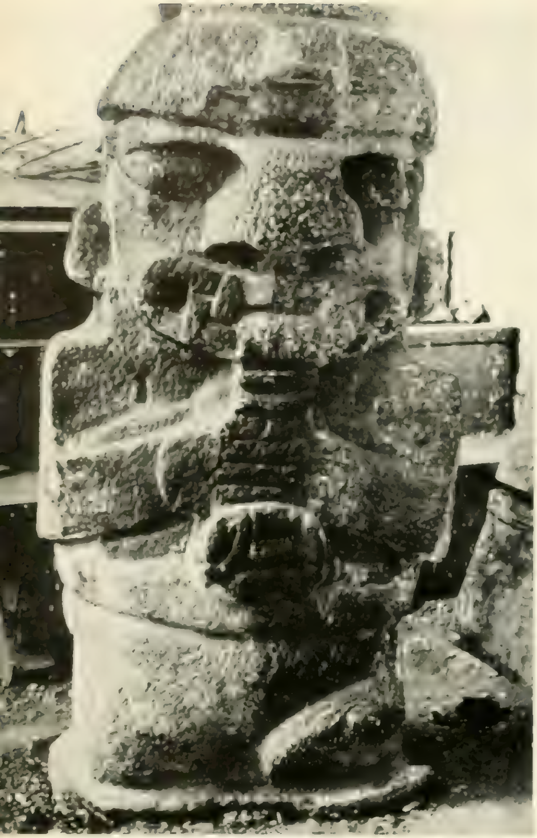
Round about spreads the country of Colombia, a country that is built up and down, with abundant high mountains and endless lovely plains and woods, the Amazonian forest.

Our trip through this diversified land to the ruins of San Agustín takes two days. Traveling either by automobile or by train toward Girardot on the Magdalena River, we traverse a magnificent landscape, with the vegetation changing every hour as we descend the mountain. First pastures lie on either side, with crops of wheat, potatoes, and maize. Then coffee appears, and finally more plantations but of different kinds, larger and larger ones, with palm trees, cotton, tobacco, and sugar cane.

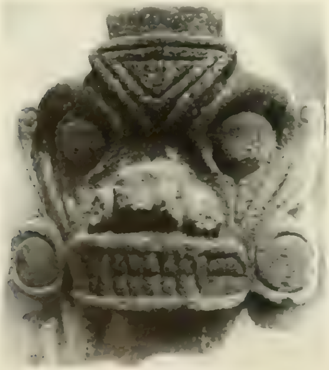
Traveling westward on this leg of the journey, the

(Below) A MASSIVE NINE-FOOT HEAD, situated at the foot of a mound near San Agustín where it may have adorned the principal approach to a temple





FIERCE-LOOKING PAIRS of catlike teeth are characteristic of many of the stone gods of the San Agustin people. The statue above, found at Isnos several miles down the river, has been taken to the city hall; and the head below resides in the plaza



[illegible] has faced the snow peaks of Tolima, Santa Isabel, and Ruiz, perched high peaks in the central range of mountains, where [illegible]. At Girardot on the banks of the Magdalena [illegible] southward and towards the valley of the Magdalena, [illegible] river, which is navigable [illegible] about 1000 miles from the Caribbean Sea.

The ancient ruins which are our goal now lie directly [illegible] to the south, near the city [illegible]. We travel through [illegible] lying between the eastern and central ranges of mountains toward the snow slopes of Huila, or Nevado del Huila, from which the state takes its name.

After [illegible] the traveler comes into Neiva and finds the Continental Hotel. [illegible] Happily enough, one can proceed immediately by automobile to the southward. In the gathering dusk we ride through lovely though scarcely visible landscapes, past villages and [illegible] toward the very source of the Magdalena River, toward the Valley of San Agustin and its multifarious stone giants.

I think I am correct in saying that despite the unrest that disturbs many other parts of the world today, you will find the country in which you are

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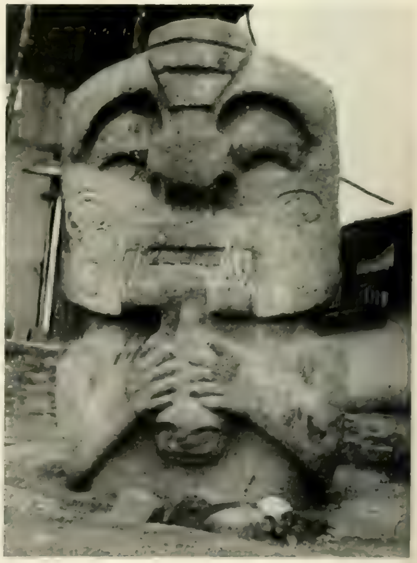
THE CARVED GOD below is apparently in the act of extracting an animal from his mouth: an imposing relic left by the ancient people for future archaeologists, a short distance from San Agustin



traveling most pleasantly friendly to the United States. Colombia has ten million inhabitants and an area equal to that of California, Oregon, Washington, and Montana. Last year in November the National Congress voted a bill authorizing the government of Dr. Eduardo Santos to lend 50 million dollars to build air and maritime bases. By so doing, the Government of Colombia hopes to be able to do its duty in the event that it should be necessary to defend the Panama Canal, vital to all of us. And the North American people can be quite sure of that.

When you realize, as you approach the sleepy town of San Agustín, that it has been possible to reach this remote center of ancient culture in four days from New York City, you will no doubt feel that you have been taken on a magic flight back through time, to be set down in another world. Indeed, the transition is so rapid by clipper plane that many prefer to take the two-week journey by ship, boat, and train which gives opportunity to see a great deal more.

Presently we reach San Agustín, in all its tranquillity. The first person who paid attention to the ruins of San Agustín was Francisco José de Caldas, a man of letters and great knowledge, nicknamed *El Sabio Caldas* ("The Wise Caldas"), a close friend of the celebrated naturalist, Alexander von Humboldt. He was killed by the Spaniards a century and a half ago. He was a patriot and also a scholar; but, as so often happens in many countries to wise men, who love so much to look at the stars without seeing the danger behind them, he allowed the Spaniards to catch him and was shot.

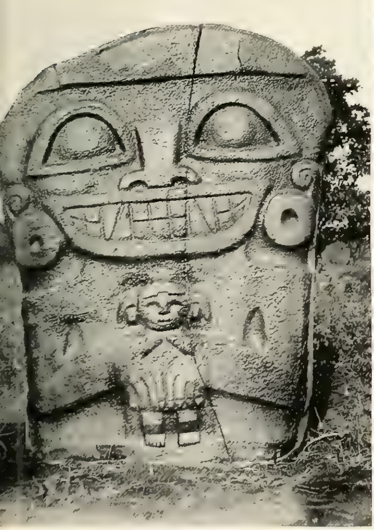
No one, however, paid attention to him in connection with the ruins. Not till more than a century later, only 25 years ago, another man of great intellect, Doctor Preuss, formerly Director of the Ethnological Museum of Berlin, paid a visit of six years to the ruins and wrote a handsome book on them.

Which brings us to the interesting fact that, unlike most of the other great ruins of the past, those of San Agustín have yet to give up most of their secrets. Preuss himself acknowledged that he could not discover where these sculptures came from nor what other culture may have influenced the artists.

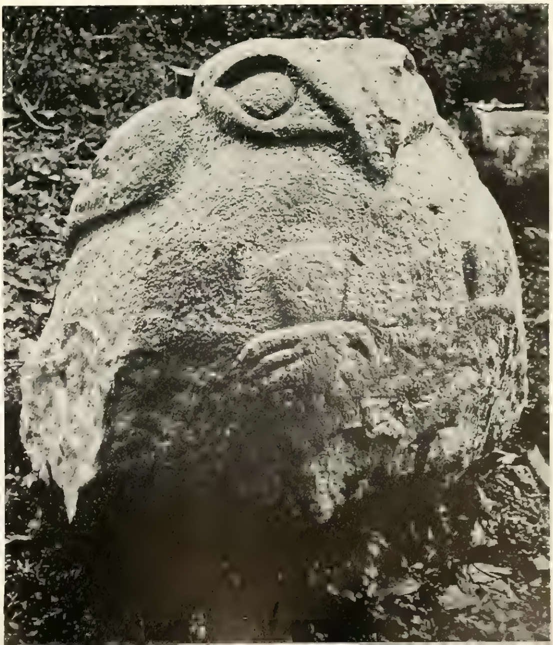
Not being the director of any museum, there is small hope that I may tell more than he did. But this I can say: that you of North America are heartily invited to visit our country and its ruins, you who love our Indian art, our common cultural heritage. The Government of Colombia is now ready to make arrangements for a joint archaeological expedition to San Agustín and the big archaeological sites surrounding the town. There perhaps lies the key to the full knowledge of our prehistoric past.

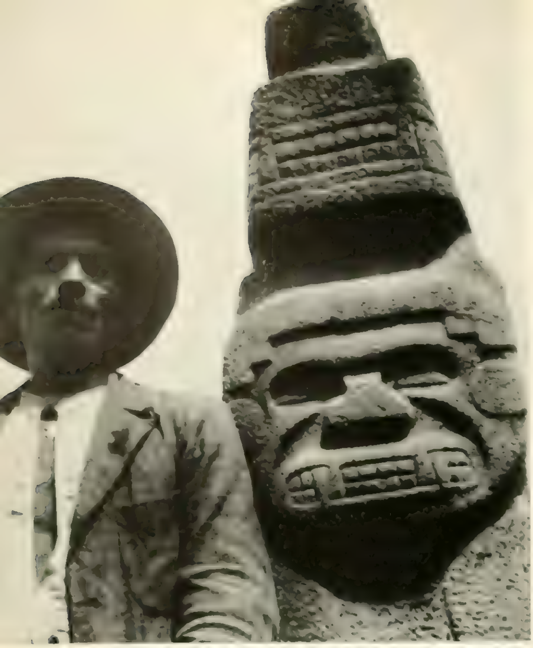
And now, look, please, at the statues, for in matters of art an impression cannot be conveyed by word alone.

(Below) GODDESS with child in arms: a four-foot statue introducing the feminine element in the art of early Colombia. This was discovered in 1937 by José Pérez de Barradas, Director of the Archaeological Commission



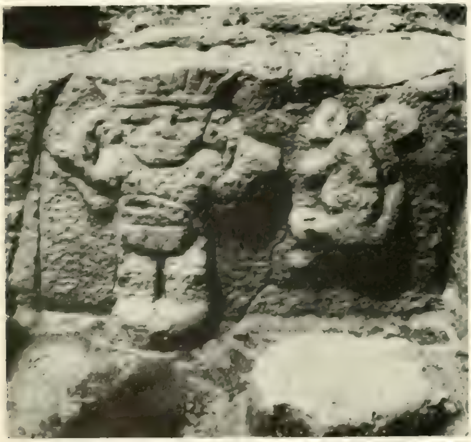
(Below) A STONE EAGLE carrying scepters in its claws, also found in 1937. Further work is expected to reveal much new material shedding light on the position of this culture in the archaeology of South America



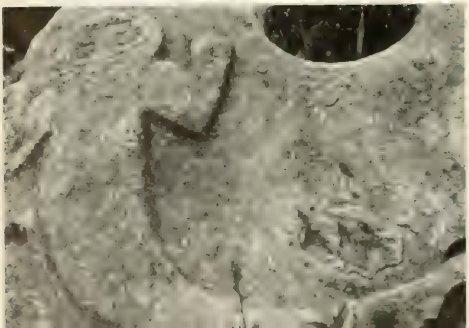


(*Above*) ONE OF THE POOLS of a ceremonial fountain, possibly used for rituals of sexual significance

(*Left*) A MODERN NATIVE of the region stands beside a statue of a male figure apparently surmounted by the stylistic representation of an animal. With the conspicuous eyeteeth typical of this ancient art, this figure looks out from the eastern bank of the Lavapatas River a few miles back of San Agustin

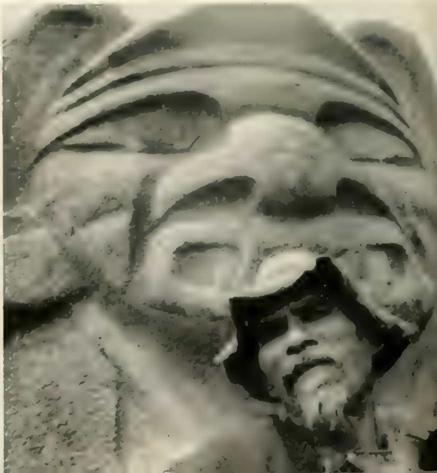


(*Left center*) FIGURES decorating the pool of the "Fountain of Lavapatas" shown above



(*Left, below*) A HUGE CIRCULAR stone bearing the snake-like figure of a sacred animal, or zoomorph

WITH bold and imaginative features, the gigantic deity below surveys a tranquil land whose present inhabitants can give the archaeologist no knowledge of the ancient race that left these imposing monuments



A NAVAHO MAKES SOAP *(99 44/100% Yucca)*

By ALEXANDER AND DOROTHEA LEIGHTON

Photos taken while under grant of the Social Science Research Council

1 Raw material: the broad-leaved yucca plant

2 *(Below)* Soap comes from the root

3 *(Below)* . . . which is peeled

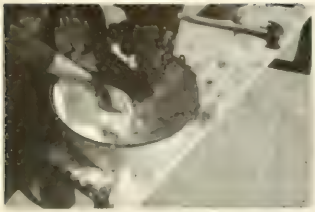
4 . . . and sliced

5 The slices are pounded, then dropped

6 . . . into cold or lukewarm water

7 . . . and churned into suds

8 . . . for a foamy shampoo



9 But hair must be thoroughly rinsed

10 . . . to avoid scalp irritation.

11 She brushes her hair with dried grass

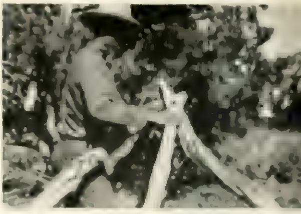
12 . . . and begins her coiffure like this,

13 . . . folding the hair into a club

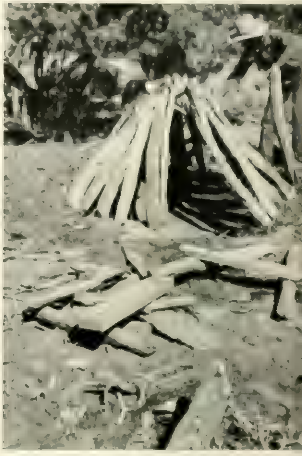
14 . . . and tightly knotting it

15 . . . so it is all fixed for 2 or 3 days

1 He starts with three forked sticks

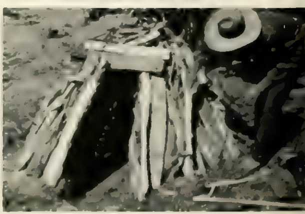


2 . . . then adds some straight ones.



3 A little boy brings cedar bark

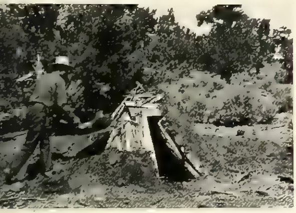
4 . . . which fills the cracks.



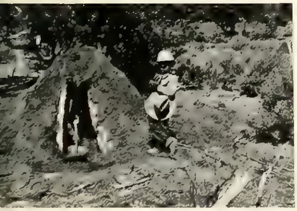
A NAVAHO TAKES A "TURKISH BATH"

By ALEXANDER AND DOROTHEA LEIGHTON

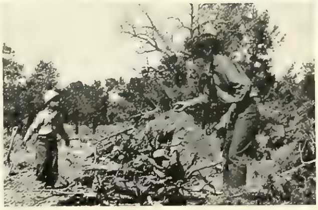
The whole house is covered with dirt



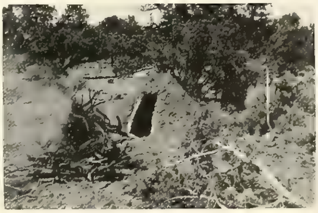
The Navaho digs out the inside



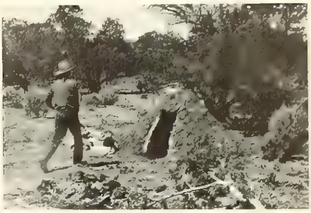
7 . . . and builds a fire



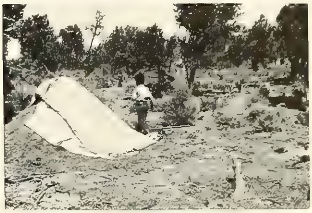
8 . . . in which stones are made very hot.



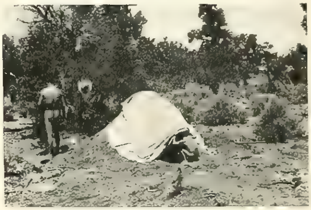
9 The hot stones are put in the hut,



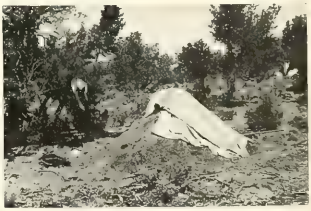
10 . . . and a tarpaulin covers the doorway.



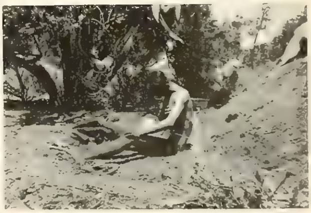
11 Clothes are hung "on a hickory limb."



12 And so to bathe—in his own juice.



13 Emerging, he rubs himself with dirt, peels it off, and so is cleaned



GEM FOR JUNE

Two lustrous jewels, the pearl and the moonstone, vie for the delicate honor of symbolizing the month of brides

By Frederick H. Pough

T[illegible] name arises from the resemblance. But aside from the realm of romantic ideas the two have little in common.

Pearls are not minerals, for they have an organic origin. They are composed of the same materials as the shell of the oyster which forms them, principally calcium carbonate. Their iridescent luster is the result of the breaking up of light rays by the infinitely thin layers of which the pearl is composed. Starting from a minute irritating granule, the animal deposits layer after layer of pearl substance over the central nucleus, gradually building up the size of the pearl. The process does not stop with the formation of a small pearl, but is continued throughout the life of the oyster, clam, mussel, or snail making the pearl, and the pearl grows ever bigger. Pearls are made by many animals—probably any that can secrete a shell can also make a pearl—but few pearls are valuable. The luster of a pearl is the same as that of the inner shell of the animal responsible. If it is the common edible oyster, the pearl will have the negligible luster and beauty of the inside of an oyster shell, and its value will be correspondingly low. Newspaper stories to the contrary, notwithstanding, the pearls of our edible clams and oysters are practically worthless.

Engraved moonstone from Ceylon

In many parts of the world, however, there is a related oyster which is said not to be very good eating but which produces a beautiful lustrous shell, and this is the oyster in which our precious pearls are found. Their slight variations, according to where they are found, enable the expert to tell the origin of any pearl by the nuances of color and luster. Pearls of the Persian Gulf and of the South Sea Islands [illegible] most valuable today. The Japanese natural pearl industry has been wiped out by the much securer system of the artificial cultivation of pearls; man's introduction of a good-sized irritating nucleus has supplanted the natural introduction of small ones. From such large beginnings the oyster is spared many years of work. Often today a few thin layers suffice for the cheaper culture pearl necklaces, but these layers will wear away almost as quickly as they were applied.

Pearls have been highly valued for many years, and a favorite myth tells of dissolving pearls in wine or vinegar to make a precious drink. Cleopatra is supposed to have drunk such a draught, made during a banquet for Mark Antony. But if the pearl were really dissolved before the meal grew very cold, the fluid must have been a potent drink which, we fear, no lady could down. Pearls can be dissolved however, even in weak acid; they are soft and are easily worn away. Few pearls from graves have any luster remaining, because the minute crystals of the thin layers have re-formed in larger sizes, and the delicate sheen is thus lost.

The Romans believed that pearls were solidified drops of dew which fell into the oysters, presumably at low tide. Hindus thought that pearls came from many animals, the most and best from oysters of course. The Chinese still believe in the medicinal properties of the pearl, and many small and badly formed pearls are used in this way. The Arabians and Persians use pearls as cures for insanity and for various diseases.

All other gems are sold by carat weights—one carat is 200 milligrams, five carats equal one gram. Pearls alone are sold on another system, by grains. Four grains weigh the equivalent of one carat. Values vary according to color, shape, and perfection, and with the larger pearls, as with other unusual gems, it is a matter of an individual price for something unique.

Moonstone, the alternative stone for June, is a variety of feldspar, one of the common rock-making minerals, but in an unusual form. This gem is colorless to slightly milky, and it possesses a remarkable bluish sheen, which is enhanced in a convexly cut stone. Most moonstones come from Ceylon. They are regarded as sacred in India and are always displayed upon a yellow cloth, a sacred color. They are highly prized as a gift for lovers and are thought to arouse love and give lovers the power to foresee their future fortune. Perhaps the moonstone is appropriate as the birthstone for June after all, even without the rhyme the English language supplies.

Exquisitely carved pearl shell from Japan

[illegible]

GEM FOR JULY

Assistant Curator, Geology and Mineralogy, The American Museum of Natural History

The blood-red ruby, costliest jewel of all, has derived its virile attributes from the symbolical color of Mars

UNBELIEVABLE though it may sound at first, the rich deep red of July's stone is caused by the same impurity that gives the emerald its brilliant green. Although this impurity, chromium oxide, is unessential to the basic mineral composing either the emerald or the ruby, it is what gives both gems their color and value. In a sense, therefore, chromium oxide, though common enough itself, is the most valuable commodity in the world when purchased in the form of a ruby. When one considers what a slight amount—little more than a trace—transforms a common mineral, corundum, into one of the rarest of gems (provided, of course, it has the clarity and purity essential to any gem), it would be difficult to put any price on it. Even radium could not approach it in cost.

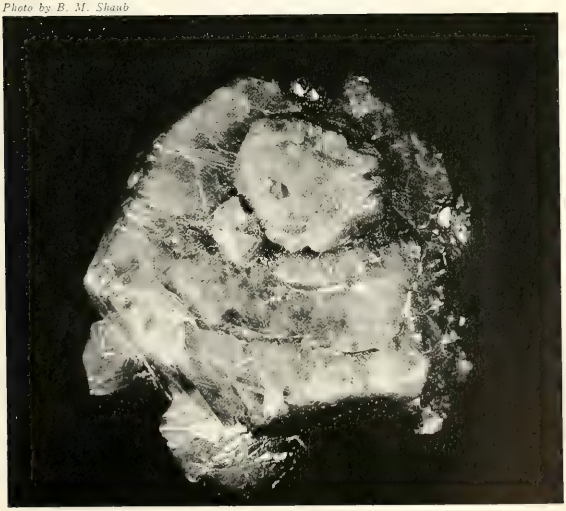
Ruby is one of several corundum gems and is the most valuable and the rarest of all. Fine quality large stones are far rarer than diamonds of equivalent size and quality. Corundum is a common mineral of very simple composition, consisting of aluminum and oxygen,—nothing more. But this compound is the second hardest mineral, exceeded in nature only by the diamond. Corundum is usually gray or brown or greenish or black, and is usually as translucent as a brick. Only rarely do we find it in transparent pieces, and flawless gemmy specimens are even less common. Ruby corundum is the rarest shade, and a large piece of this gorgeous color without a host of imperfections is indeed unusual.

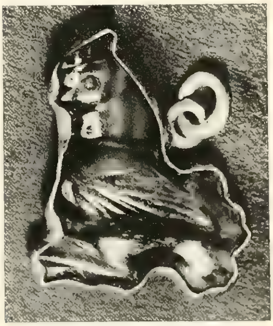
Ruby is found in but few places. The best gems come from Burma, and only these have the bluish-red, "pigeon blood" color. Ceylon rubies tend to be lighter and are less highly valued. The ancients confused various red stones, so that garnets, spinels, and rubies were often thought of interchangeably as rubies. Some of this tendency, if not the ignorance, continues to this day, and we frequently find names like alabandine ruby, Cape ruby, and Arizona ruby applied to garnets. However, the carbuncles of the ancients were often rubies, and many of the legends of carbuncles should probably more properly be applied to rubies than to garnets. Because of their glowing color the myth arose that they contained an internal fire, a fire which could not be quenched nor concealed no matter what cover were placed over it or what cloth wrapped around it. A ruby in water was thought to warm it, eventually bringing it to a boil. Sometimes sex was attributed to gem stones, including rubies, and the darker stones were thought of as being male, the paler ones as female.

In recounting these ancient myths, one would naturally think that so many of the beliefs would be subject to test that they could easily be disproved if anyone took the trouble to try out, for instance, the boiling of water by a ruby. The explanation of their perpetuation lies in several factors, chiefly, the lack of scientific curiosity among the people. If Pliny wrote that something was so, a failure to make it work in a subsequent test was attributed, not to an error on Pliny's part, but to some fault or mistake of the tester. Furthermore, superstitious fear prevented many from trying to summon up the devil, even though they may have thought they had the means to do so within their grasp. Self-styled seers and prophets were willing then, as now, to exploit the gullible, and superstitious peasants were often deceived by tricks. A general lack of knowledge led also to an uncertainty about the nature of materials. If some test failed to work, it might be concluded that the carbuncle in question was not genuine or had perhaps lost its power in some way. All of these factors led to the perpetuation of many ideas which to us seem absurd and obviously fallacious.

A Burmese ruby crystal (in the Harvard Gem Collection)

Photo by B. M. Shaub





AMNH photo by Coles

Carved ruby rooster (three times actual size), from Burma

Like many stones, rubies were thought to have the power of foreseeing unhappy events. There are many stories of stones that turned dark upon the approach of ill fortune and became brilliant again when the future promised better things. As with other red stones, an association of ideas made the ruby a stone of curative value for any sort of bleeding. Red was the strongest color, and as such was the color of Mars; on a man it signified command, nobility, lordship, and vengeance. Consequently, it was appropriate as a man's gem. Rubies were thought to have caste: the deeper colors were of the highest caste, but stones, too, could lose both caste and supernatural power by coming in contact with the paler stones of a lower caste. In the older breastplate, ruby was the stone for December, but in modern times it was thought more appropriate for a warmer month; hence, we have ruby as the jeweler's birthstone for July.

A JAGUAR FOR THE MUSEUM

By C. V. Whitney

Like a mirage in the desert, the elusive "tigre" escaped five expeditions bent on his capture

"He will remind you of summer lightning"—A small scale model of the Jaguar Group, designed by Mr. C. V. Whitney and Dr. James L. Clark for the new North American Hall

Four years ago I attended a meeting in the American Museum of Natural History in which President Davison outlined the plans for the new North American Hall, a hall in which the most important and interesting animals of the land would be displayed in their natural settings. It was a magnificent conception, to create within four walls in the heart of New York City an exhibit that would have scenic beauty, as well as educational and scientific interest for thousands of people who would never otherwise see the wonders of our native wildlife.

Since the age of fifteen I had made hunting, camping, and fishing trips over many parts of North America. I have a deep feeling for the marvelous wildernesses of the North American continent, for the variety and grandeur of its scenery, for its different peoples, and for its beautiful wildlife.

President Davison's plans appealed to me immensely, and I undertook the responsibility of providing and donating one exhibit for the new hall, a group portraying the southwestern desert country, with the mountain jaguar, or *tigre*, as its principal subject.

I visited the Southwest first in 1923, going to Arizona and Sonora, Mexico. Every winter since then I have lived in this area, on and around my farm in Sonora, about 300 miles south of the United States border. During this time I made many trips over the surrounding country, and I was completely under the spell of the desert. Why, I shall never know,—for it is a hard and pitiless land,—hot and dry during winter and impassable and unendurable during the summer rains. But its sublime moments are its sunsets and cool nights and the utter lack of a sense of time, the philosophy of mañana.

The people in this land still depend upon wild game and birds and fish to supplement their food supplies. Cattle and farming are their chief industries, so that the wild animals that affect these are important daily topics. Foremost among them is the jaguar *(tigre grande)* who kills their stock. There are other animals in this great southwest desert, deer, peccaries, bear, mountain sheep, antelope, mountain lions, and wildcats. There are many varieties of birds; I have seen the skies black with geese, and long lines of sand hill cranes winging their way to the shores of the Gulf. I have shot seven varieties of duck on a small watering pond for cattle. There are bobwhites, parrots, scorpions, and snakes; butterflies, hummingbirds, and eagles; yet when you are there you are more conscious of dust, flies, and heat than of all the rest.

If you travel to any extent in this country you will hear much about our friend the "tigre." You may see at firsthand the evidences of his depredation. I have seen two full-grown Hereford bulls killed within 100 feet of each other and left lying there with their throats severed, but nothing eaten. If you camp in the country, ranchers may travel as far as 50 miles, having heard by the grapevine that you are there with hunting dogs, to implore you to come and kill the "tigre" who is destroying their live stock.

Occasionally the natives kill a jaguar. They lie in wait near some mountain spring night after night until by luck the beast should come there to drink or kill a deer; or, one of their mongrel dogs will locate a "tigre" too stuffed with food to run or too lazy to be annoyed. But not many are killed in this way.

I made five expeditions to secure a male jaguar for the Museum, but failed. The animal was finally secured three months after my last attempt and at the exact location where I myself had been hunting! On all my hunts, dating from 1929, I was accompanied by Les Wooddell of Nogales, Arizona, a cowboy by profession but a good hand at any outdoor job. You could not wish for a better companion. He will drive you hard but do it with a laugh, and he has a sense of humor, which saves many a situation.

It remained for Les and Miss Mary Ogden Abbott to secure the jaguar three months after my last attempt, and her story follows. He is a fine specimen, and we are not ashamed of him. He lived in the Bacatete mountains, the last stronghold of the Yaqui Indians, and was a legend in the small villages within a radius of 100 miles.

In the exhibit being prepared for him in the North American Hall, you will see him as he was in real life, the monarch of all he surveyed, in the setting of that wild and awe-inspiring country in which he lives. You will admire his muscular display and perfect symmetry; he will remind you of summer lightning.

The Pursuit of

OLD JUAN

By Mary Ogden Abbott

With sketches by the author

The hardest kind of riding over cactus and boulders was necessary for a glimpse of this magnificent creature—who soon will be viewed by countless thousands in the full beauty of his natural surroundings in the American Museum

Early last January, I received a wire which read, "HAPPY NEW YEAR, EXPECT YOU FEBRUARY FIRST," signed Les Wooddell.

The telegram called my bluff on a series of one-sided jests connected with assisting Les to collect what he calls "a big stud tiger," otherwise known as a jaguar or *Felis onca,* for the American Museum of Natural History.

I replied immediately, asking if he would be seriously inconvenienced if I did not arrive until February 4th. The whole idea continued to retain its charming suggestion of total improbability even after I had engaged a passage on the "sky sleeper."

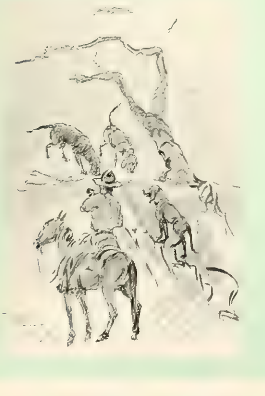
On Tuesday the 4th of February, half an hour before dawn, I arrived at the airport of Tucson, was met by Les, and proceeded across the Mexican border to his new ranch in the Yaqui reservation, 300 miles south of Nogales.

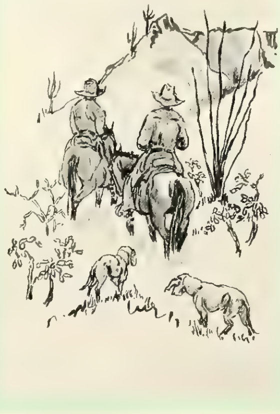
Ever since a year before, Les had been hunting the *tigre* who, from then on, we knew as "Old Juan." The Museum people were getting impatient, writing that everything was ready to finish the jaguar group, except the most important jaguar. Mr. Whitney, who was presenting the group, had suggested offering a reward for a suitable animal.

It is not easy to catch such an animal in the State of Sonora, or anywhere else if you need one badly. They are not plentiful, and the range of the individual animal is wide. He may leave the country entirely; and, like all game, the big ones grow wary and drift farther than the less desirable specimens. In Sonora they are hunted with dogs, chiefly bloodhounds or a cross between a bloodhound and a fox or a coon hound. Not only are the scenting conditions extremely difficult on account of the dry ground and the heat, but water is scarce in that country, and the cactus is everywhere. The brush is thick, and where other things are not so bad there is likely to be a feather grass that gets into the dogs' noses. The dogs must be trained to ignore the numerous deer. Finally, a jaguar is a large and powerful animal and he is more than likely to turn to bay and kill or cripple a whole pack of hounds. This happened to Mr. Whitney's packs on two occasions.

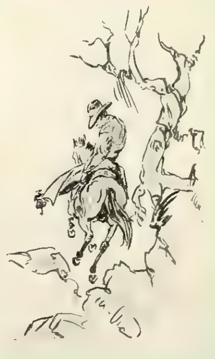
We traveled from Nogales to the ranch in a Chevrolet truck, accumulating supplies, Ramus, the Mexican hunter, Analito, the camp tender, and vari-

"Time and again the dogs tried to straighten out the trail . . ."





"We followed . . . where a mistake meant a caught foot or a broken leg . . ."



[illegible] and [illegible] we went. On returning to the valley we were treated to a sunset of unparalleled drama, which culminated in a blast furnace effect as the sun appeared [illegible] against the clouds through a notch in the western Sierra.

On the ranch there were no tracks of Old Juan, so we moved camp and hunted the south end of the valley for two days. Nothing was found but old tracks and disappointment. Strange and picturesque Mexicans and Indians showed up at intervals, camped with us the night, and departed. Captain De Broussio, who lived at Agua Caliente, a small, desolate and dusty military post in the valley, provided us with mounts, hunted with us briefly, and left. He was very amiable, very silent, and a competent horseman.

The nights were brilliant with the great full Mexican moon. The dawns (we always rode at dawn) were pearly and cold as death. One longed for the sun, knowing that toward noon one would grow to hate it. The grass stood dry to a horse's belly, the cactus stuck in the dogs' feet and hide, the saguaros pointed to the sky, and the thorns, which protect almost every brush, tore at the rider.

All the tracks of "big ones" were old and they all tended toward the mountains on the west. But at last came a report that fresh tracks had been seen near the Agua Verde, over against the Sierra del Gallo to the west.

We moved camp that night to a tree in the center of the dusty expanse that lies inside the fence at Agua Caliente, and at four o'clock the next morning we broke camp. The horses were sent on eight miles west. We followed in the truck escorted by two Yaquis armed to the teeth and shod in sandals.

Shortly after sunrise we started on the serious business of trying to outguess Old Juan—Les, Ramus, and I mounted, and the two Yaquis afoot. We rode through dense, stiff, leafless brush which grew among large loose black stones. A mounted man could disappear in 20 yards. It was bad going and got worse.

We finally emerged in a boulder-filled arroyo, difficult for ponies, but easier for the Yaquis. On the sandy places Les and Ramus pointed to signs indicating that Old Juan was in the habit of going up and down here, but he had not passed recently.

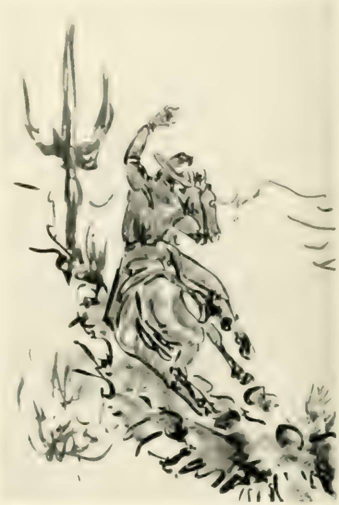
The morning wore on, the dogs found no scent, and the ponies picked their way over and among the boulders. There is a special name for that black boulder country, but it was easy to make up other ones.

At last we came to some pools of water in the arroyo; the water looked like pea soup. The dogs swam about in it with relish, and the horses drank. Les discussed the situation in his expressive Spanish, which is nothing but an agreeable sound to me.

At noon we stopped by a charming pool of clear water with a grassy place near by. A duck flew up from it. I produced the lunch, which consisted of a handful of raisins all around and a small piece of cheese.

No sooner had I dismounted than the dogs began to "bawl" on a track of something in the brush. We mounted and followed them as they made a loop up the hillside. Time and again the dogs tried to straighten out the trail, but could not. Finally Les called them off, saying he would rest them and let them try again.

We dismounted and sat about, ate our raisins, and waited. After about an hour the dogs tried again, but they could not take the trail out of the arroyo. After this was certain, we proceeded along the arroyo and stopped again. "No use to trail the dogs back to camp in the heat," said Les. This time when we dismounted I went to sleep with my head on a stone, which made me realize I was tired.


"The rocks slid under Les' pony, he threw up his arm to keep his balance, caught my eye and grinned . . ."

After five o'clock we prepared to start for "home"—the truck. I staggered to my feet and reset my saddle. No one but me likes that saddle. It was acquired in the bazaar at Athens, and my mother rode it from Hermes, via the Temple of Basse, to Sparta. I believe it was a Russian army saddle. It was embellished with a pair of Army stirrups, from which the brush of Sonora effaced the "U. S." in ten days! I seemed to be the only person below the border who knew how to put it on a horse.

We went out of the arroyo and climbed up a narrow trail onto a "bench," interlaced with more cactus than any stretch I'd seen. Suddenly, on the trail behind us, the dogs picked up a scent. They carried it under the horses, ran it up the trail, checked and turned back, and then turned off into the brush and cactus toward a side hill and the setting sun. They worked it over the bench and through the cactus with only two errors.

Following Les and Ramus, I thought, "If the dogs get the line into the shade it will be all right." Ramus found a track and said something to Les, just what, I was afraid to ask, having decided for myself that this was Old Juan. At the foot of the slope the scent freshened and the cactus was thinner, but the footing worse. The dogs went over the top, and we followed as fast as we could, over boulders where a mistake meant a caught foot and possibly a broken leg for our horses.

The brush grew higher and snatched at our bridle reins. We had to fend our faces, dodge, and try to give the ponies as little trouble as possible. My pony was nothing short of miraculous. He was old at the game and never hesitated for his footing or made a mistake. With a mouth ordinarily extremely sensitive, he never threw up his head or faltered when the brush dragged at his rein. He never stepped on a loose stone and would jump a bad place onto a pile of boulders that did not slide.

When we reached the top, the dogs were on the side of another ridge ahead, still going strong. Going down was worse than going up, but I knew that where the other ponies could go mine could go better. The rocks slid under Les' pony, he threw up his arm to keep his balance, caught my eye and grinned. My pony followed him, and no rocks rolled,—on down a place where only goats should go, and up a steeper one. When we reached the rim the dogs had the cat at bay in the flat below. The sun was nearer the horizon, and time pressed. Ramus looked for a way down, said something to Les and, rather to my astonishment, turned back from the cliff. Finally he found a way that could not have been steeper and still passable, with loose black stones. I held back for Les to follow him because the dogs and cat had moved again. To my surprise, Les seemed to expect me to go ahead and said as I passed, "Hold on to the trees as you go down, so that if your horse falls you will slide clear." Even Les thought it rough country; he'd asked me twice if I was all right!

When we reached the arroyo at the bottom, the dogs had moved again but were still in hearing. We kicked our ponies into a gallop, and Les started taking down his .30-30.

The awful thought crossed my mind, "Suppose it is only a *little* cat!"

As we approached the sound of the dogs, Ramus pointed to a big tree, and there in the branches against the setting sun was Old Juan. Les dismounted and I after him, determined to see this fabulous animal. Les had vanished in the brush, and of course I got almost in front of him! I heard an angry voice and then a shot; Old Juan lost his footing and fell to a lower crotch. Les fired again and the animal came down. Ramus appeared, and we all embraced one another. The dogs worried the carcass for a little out of politeness, but for them the show was over. Les started to protest that the animal was not very big and only had big feet, but I thought him a perfectly magnificent specimen.

Les and Ramus cleaned the animal, lashed him across Ramus' saddle, and we pulled out for "home." We watered the horses at the Agua Verde, which was luckily near by, and continued.

There was no trail, the brush was thick and the going rough. Ramus' horse carried more than double, for Old Juan weighed over 180 pounds. It was impossible to ride a straight line, for the cactus was thick in patches or the rocks impassable for tired horses. The light was almost gone when we came to a place where the land broke off in rock slides. Ramus said his horse could not manage them. The ground was hardly visible to us. Les kept turning left, trying to get down. He said, "There is a trail somewhere, if I could find it." At last he discovered a passable descent, and within 50 yards we struck the trail!

We had ridden hard about four miles while the dogs were running, and it must have been ten miles more to the truck. The light was gone and the stars were out. I felt that the way would never end, and my horse went sore on the hard road. I let him trail along behind; and when we got in, I was "out" on my feet.

We packed the truck and pulled out for the ranch arriving at one o'clock or later. The hunt was done. The jaguar for the Museum and I were headed for "civilization."

Every year many New Yorkers as well as multitudes of people from other parts of the country [illegible] long distances to [illegible] the [illegible] of the Grand Canyon of the Colorado River, never knowing that within [illegible] miles of Manhattan there is a canyon about [illegible] miles long that is comparable to the Grand Canyon in depth, and probably more spectacular in appearance in that it is less than half as wide at the rim. We cannot compare the two in scenic effect. We do not know whether the [illegible] coloring of the rocks of the Grand Canyon region is duplicated here or not, for no one has ever seen the canyon! It is a submarine canyon [illegible] feet below the surface of the Atlantic, [illegible] whose mouth lies at least [illegible] feet deep.

Although the Hudson Submarine Canyon has never been seen, it has been quite accurately mapped during the past decade by the United States Coast and Geodetic Survey. The scale model of it, shown in the accompanying illustrations, has recently been completed in the American Museum of Natural History and is now on exhibition in the Hall of Ocean Life.

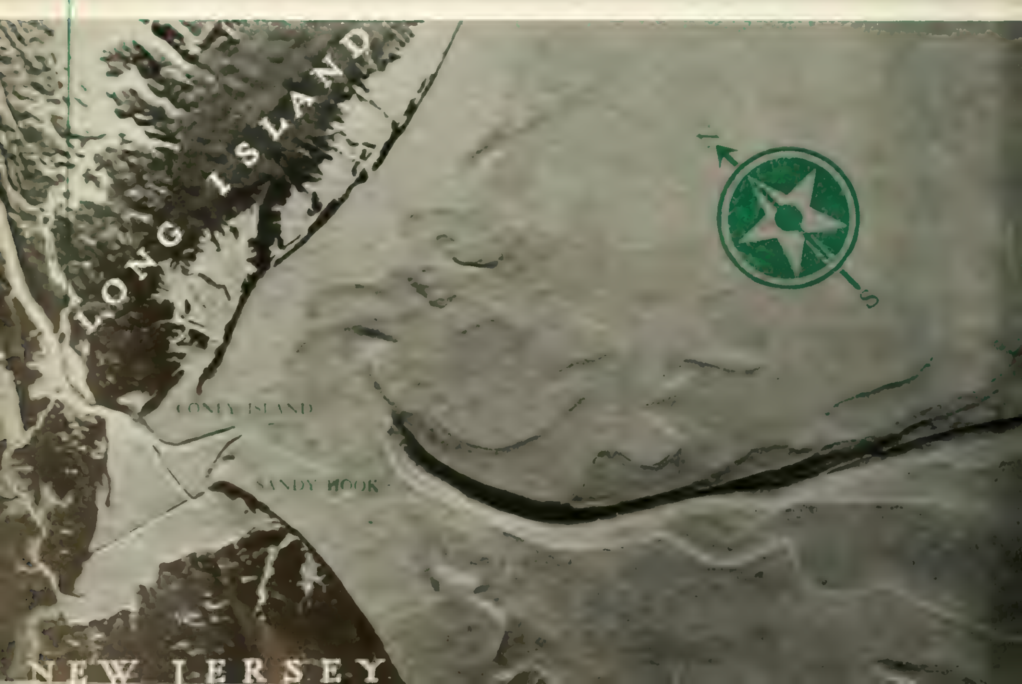
The existence of the canyon has been known for only a little more than half a century. It was in 1885 that Captain Lindenkohl of the United States Coast

CANYONS UNDER THE SEA

By H. E. Vokes

[illegible]

Equal to the Grand Canyon in depth and having more precipitous sides, Hudson Canyon remains one of the great mysteries of the deep, for it represents a strange family of submarine features which no scientific facts can explain

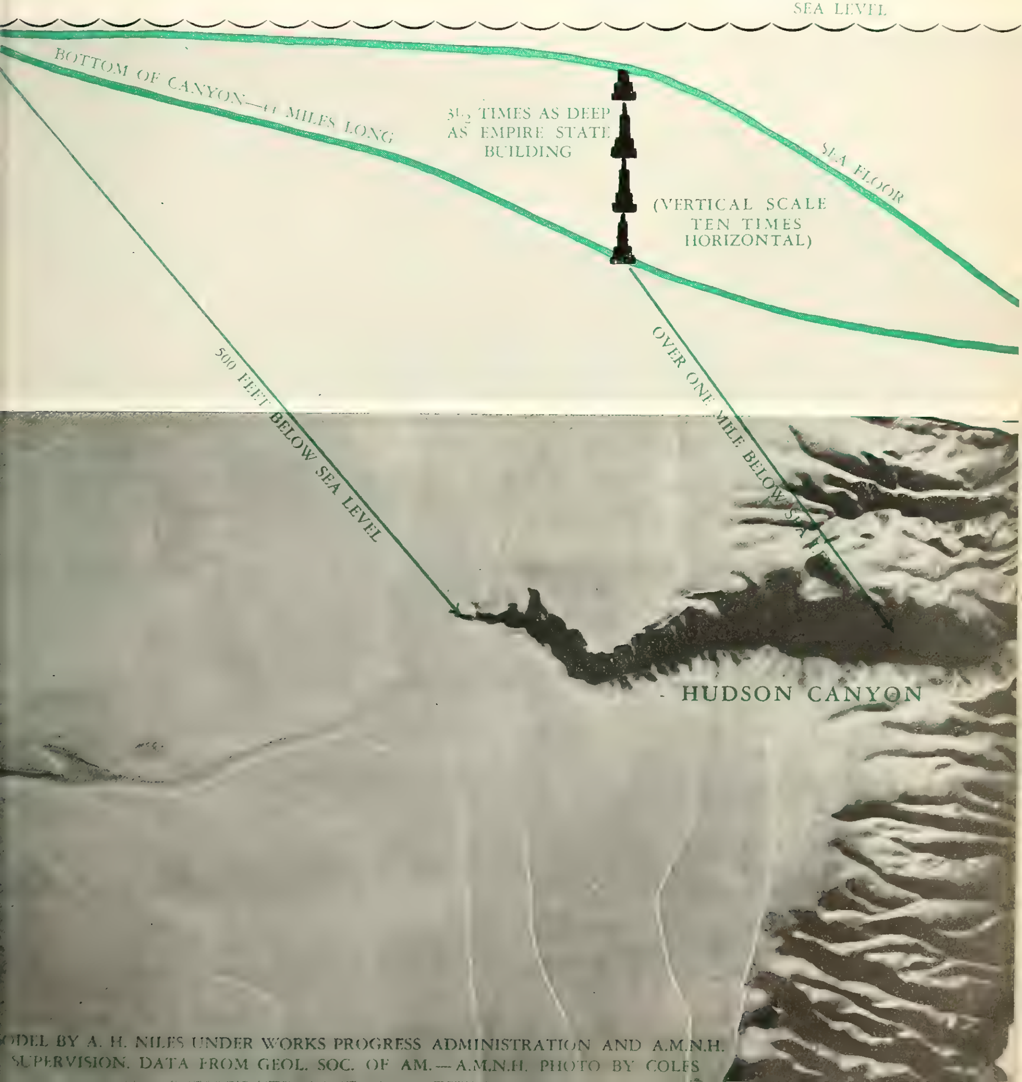


and Geodetic Survey first announced that a *ravine* had been found at the edge of the continental shelf, near the end of the known submarine channel of the Hudson River. Only recently have deep-sea sounding methods demonstrated that such depressions are common features along the margin of the continental shelf and that they possess a depth and length such as to make the term "ravine" hardly appropriate.

On land, canyons are found cut into highland areas, either in mountains or plateaus. Their mouths are always at the lowest part of their course, generally where the highland slopes to join the lowland. They are almost invariably formed by moving water, either that of flowing streams, or by water frozen to form the ice of glaciers.

In the sea, the canyons are found in somewhat similar "terrain," being cut into the margins of the continents where these drop off into the true ocean basins. One is likely to consider that the edge of the continent is where the land dips beneath the sea. Scientists have long recognized, however, that the continents are great uplifted blocks, whose real margins lie some distance out from shore, at a point where the bottom drops off rather abruptly to the true ocean basin. In other words, the surface of the continent passes gradually beneath the surface of the sea

UDSON CAN-
ON BEGINS
3 MILES
ROM NEW
ORK CITY


SEA LEVEL
BOTTOM OF CANYON—[illegible] MILES LONG
3½ TIMES AS DEEP AS EMPIRE STATE BUILDING
SEA FLOOR
(VERTICAL SCALE TEN TIMES HORIZONTAL)
500 FEET BELOW SEA LEVEL
OVER ONE MILE BELOW SEA LEVEL
HUDSON CANYON

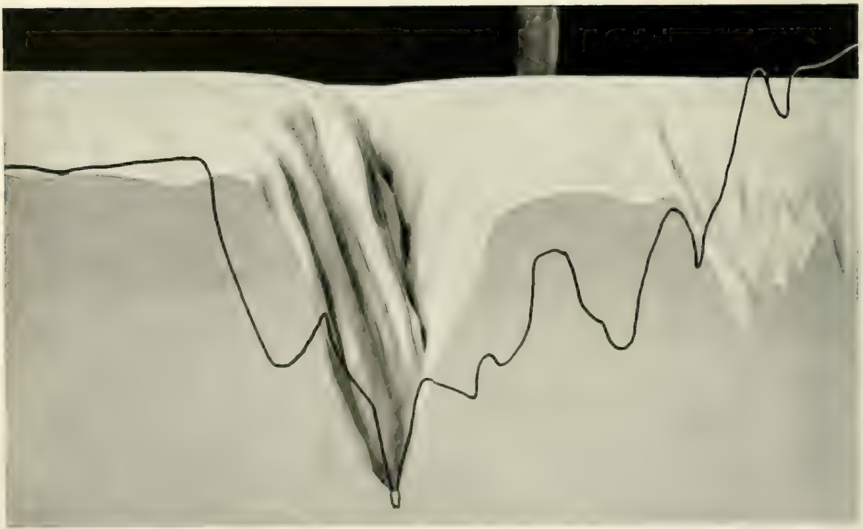
ODEL BY A. H. NILES UNDER WORKS PROGRESS ADMINISTRATION AND A.M.N.H. SUPERVISION. DATA FROM GEOL. SOC. OF AM.—A.M.N.H. PHOTO BY COLES [illegible] approximately [illegible] feet in most places [illegible] point a sharper slope [illegible]. The [illegible] of the continents are referred to as the "[illegible] shelves" and the submarine canyons are all cut into the shelves along their outer edges. The new model, which shows the shape of the margin of the continent in a very graphic manner, is eleven feet long and three and a half feet wide. It represents an area [illegible] miles long and six miles wide and was constructed in the Department of Paleontology with the assistance of the Work Projects Administration, the work being done under the supervision of the writer.

Submarine surveys made during the past few years have indicated the presence of a great many canyons similar to the one shown in the model. At the present time canyons are known to occur off all the edges of the continents save on the Arctic and Antarctic slopes. Their apparent absence is probably due to a lack of adequate surveys in those regions rather than to any considerations having to do with their method of formation.

Many of the canyons occur off the mouths of rivers, those off the Hudson River in North America and the Congo River in Africa being among the most spectacular. Others occur off the Ganges, Indus, Niger, and Columbia Rivers, as well as a multitude of smaller streams. This general alignment led to an early suggestion that the canyons had been cut by these rivers at some time when the continental margins were much higher in relation to the ocean level than they are today. But the recent investigations have shown that there are many gorges that cannot be related to any modern river. One of the more interesting canyons of this type begins almost at the head of the pier at Redondo Beach, California.

When canyons of this sort first became known it was suggested that they might possibly be very old features, perhaps dating even from 200 or 300 million years ago, in the Paleozoic era, and that all evidence of the eroding rivers had been destroyed in the subsequent eras. But within the past five years we have learned that the canyons are cut into rock containing more recent fossils (Cretaceous and Tertiary), and it is now realized that the canyons are young structures, geologically speaking, probably not older than the Pleistocene or glacial period of approximately a million years ago.

The suggestion was then offered that the amount of water frozen to form the glacial icecaps of that period might have lowered the sea sufficiently to permit the rivers to cut the gorges, and that the tilting of the continents under the weight of the glacial ice had so deflected the courses of the rivers across the continental shelf as to permit their cutting the canyons which today cannot be related to any present river course. For example, a large canyon, the Wil-

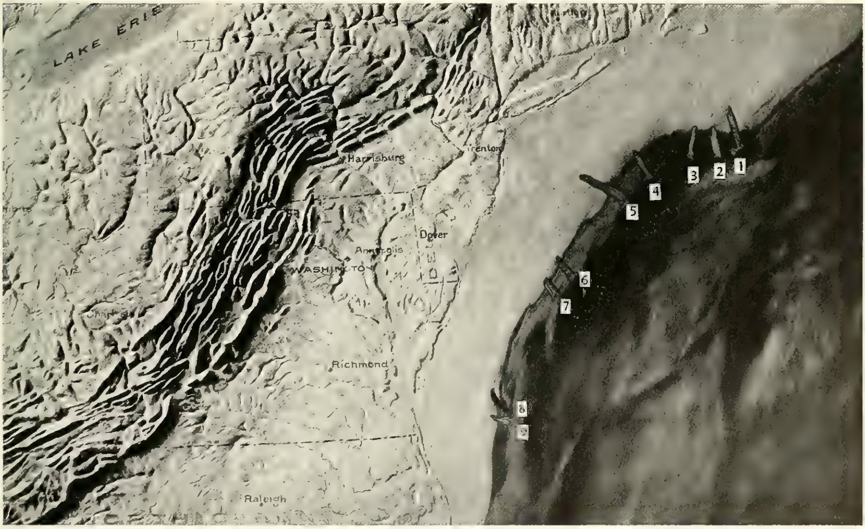


HERE a line representing the cross section of Grand Canyon is placed against the cross section of the model of Hudson Canyon. Note that the canyon 130 miles offshore from New York City has almost the same depth but much steeper sides. (Both profiles show the vertical distances ten times the horizontal) mington Canyon situated slightly northeast of Cape May, has been attributed to the eroding power of the Hudson River during one of the earlier glacial advances, while the present Hudson Canyon has been attributed to the erosion of this river during the last glacial advance. Numerous careful studies have indicated that the level of the ocean surface was indeed lowered by the water frozen into glacial ice, but all the evidence suggests that such a lowering cannot have been more than 300 feet. This is still some 200 or more feet above the level of the heads of most of the canyons, and no known river today has sufficient current to erode any such structures off its mouth at these depths.

It has been argued that we are misinterpreting the evidence and that the surface of the sea may have been lowered much farther than has been supposed. In answer to this, Professor Shepard of the University of Illinois has pointed out that the valleys extend to a depth of one or more miles and that the removal of enough water from the oceans to permit land at those depths to be cut by rivers would require the storage of about one-half of all the water in all the oceans and the piling up of an icecap at least fifteen miles thick on the continents. This seems impossible and is incompatible with all the evidence.

If the level of the sea was not lowered, perhaps the land itself rose, allowing the canyons to be cut, and then sank back beneath the sea. The amount of up and down movement necessitated by this suggestion is rather staggering to the imagination of the geologist. It would have had to occur along the margins of all the continents, and the amount of uplift would have to have been approximately equal everywhere, and the depression the same. One cannot conceive of such uniformity, geologically; furthermore, it is impossible to believe that such disturbances of the earth's crust could have occurred without leaving their mark on the adjoining lands, and there is no evidence suggesting such gigantic disturbances.

Despite the number of objections which have been raised against the possibility that the gorges were formed by river erosion, a number of students still believe that the true explanation of their origin will be found in this hypothesis. A multitude of other suggestions have been offered to explain the canyons. The recent great increase in our knowledge of their distribution and physical characteristics has shown that many of the earlier suggestions are wholly untenable. There are, however, still some five or six hypotheses which are receiving serious consideration by scientists engaged in the study of them. But there remain so many pertinent and significant objections against the acceptance of any of these that it seems probable that the correct explanation of how these gorges were formed (or are now being formed) has not yet been proposed.



Based on Plate I, Geol. Soc. America, Special Public, No. 7, Veach and Smith: Atlantic Submarine Valleys . . .

As elsewhere along continental shelves, a number of canyons are known to exist off our eastern coast. The canyons shown above are: (1) Hydrographic Canyon, (2) Veach Canyon, (3) Atlantis Canyon, (4) Block Canyon, (5) Hudson Canyon, (6) Wilmington Canyon, (7) Baltimore Canyon, (8) Washington Canyon, (9) Norfolk Canyon

THE RETURN OF A NATIVE

By [illegible]

[illegible]

EVERY year during late spring some areas in the eastern half of the United States play host to one of the strangest insects recorded anywhere in the annals of natural history, the ephemeral but noisy periodical cicada. From subterranean caverns where a generation has lived for just a few weeks short of seventeen years it emerges to disturb the quiet of woodlands and towns for a brief interval, then to drop from sight and sound by midsummer. Seventeen seasons later the progeny of this brood will come out of the soil to repeat the behavior processes in the same way as their parents and all the preceding generations.

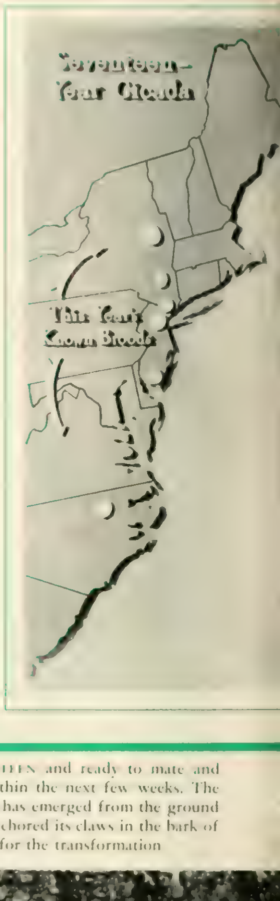
The periodical cicada, often incorrectly dubbed "seventeen-year locust," was first recorded by white man on this continent in the Massachusetts Bay Colony in the year 1634; and the cicadas that appeared in 1940 in this region were lineal descendants of this historic brood. The cicada was noted in the earliest known work on the natural history of the original colonies, a book written by a clergyman who resided in Tidewater, Virginia, before the American Revolution. It was not until the latter part of the nineteenth century, however, that the true nature and longevity, the long periods of quiet between sporadic outbursts, were understood. And today there still remain many unsolved problems regarding [illegible] patterns.

Many superstitions have developed out of man's observations on the cicada; and not all of these were originated [illegible] with war. Often those who incline to believe in the improbable, point to a distinct letter *W* in the wings as a portent of armed conflict,—in spite of the fact that the insect is always marked thus. War, however, in the light of the past record of human achievement seems a fairly safe prediction, because it seems to occur about as often as "cicada years."

There occurs a brood of the periodical cicada somewhere in eastern United States almost every year, perhaps every year. But in certain seasons the populations of the insect are so small that they may escape notice. Some broods are confined to narrow geographic limits, as is the case for 1941. The impending June invasion, as well as can be told from past records in Government files, will occur in southern and northern New Jersey, in the vicinity of New York City, in the lower and upper Hudson River Valley, and in one location in eastern North Carolina. Readers may be able to add many records to the list already compiled by entomologists interested in this species.

Some broods are very destructive in restricted areas, as for example the one which appeared in northern Illinois and southern Wisconsin in 1939. Several broods cover vast sections of the eastern half of the continent. The largest invasions during recent years occurred in 1936 and 1940. When prevalent, the cicada may cause serious damage to many shade, forest, and fruit trees as well as ornamental shrubs. Some of the oaks are especially susceptible. The writer recently witnessed areas where, after two successive severe swarms, many trees were dying and nearly all those remaining had many dead branches.

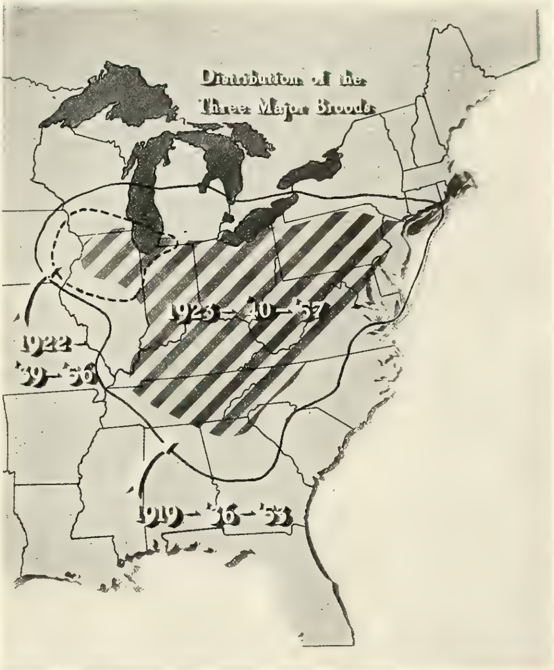
[illegible]



SEVENTEEN and ready to mate and die within the next few weeks. The cicada has emerged from the ground and anchored its claws in the bark of a tree for the transformation

THE MAP at left shows the known areas where this amazing insect is preparing this month, after seventeen years of life underground, to make its appearance for the few short weeks of sunshine that Nature allows it. Many other regions will probably also see the cicada this year, and readers can help scientists plot the distribution seventeen years hence

THE DISTRIBUTIONS of the three major broods according to the years in which they appear is shown at right. The largest and most injurious of all of them is represented by the outside line and is known as Brood X. Similar in distribution but more circumscribed is Brood XIV, indicated by stripes. The dash line indicates the restricted but severe Brood XIII



SHEDDING ITS ARMOR. The split along the back, which began in the preceding picture, has widened in the first stages of the disrobement that will result in a winged insect

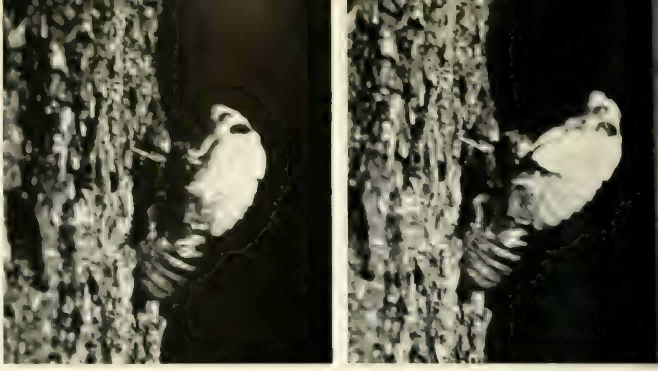
A SNOW-WHITE ANIMAL is revealed within the dark brown casing as the split widens. The transformation requires one or two hours, but cold will retard or stop the process

ONCE shedding begins, the skin is not part of the living animal and must be discarded quickly. If the insect has not anchored itself well, it will be deformed or remain imprisoned

[illegible] meaning in the literature of entomology. [illegible] ers will live to see this prediction (if prediction it can be called) come true. [illegible] may appear several times during a seventeen-year interval, but the elapsed [illegible] sixteen years and ten months in the ground as an embryonic animal and enjoys adult existence for about one month.

During late winter or early spring the cicadas that will mature in the approaching season start burrowing upward through the earth and come to rest just beneath the surface a few days or sometimes a few weeks before they are to emerge. They may open their tunnel to the air some time before they come out. Often they construct mud turrets similar to those of the crayfish, though this is a variable phenomenon. The almost rhythmic appearance of these insects, starting just after dark and continuing until about midnight, is like something out of Jules Verne or H. G. Wells. Each night for about three weeks the emergence continues in the same manner. The almost mature nymphs emerge awkardly from their caverns and proceed slowly across the ground to a near-by tree, shrub, post, or whatever they can find to climb. Where cicada populations are heavy the movement of the insects across the surface vegetation can be heard distinctly for a considerable distance, and it is impossible to walk across such lawns or woodlands without stepping on them. Long undisturbed places such as shrubbery borders and orchards may have more than 100 cicada nymphs per square foot of soil.

When the nymph leaves its burrow and climbs a tree or shrub, it is still an immature individual, a subterranean animal that must soon discard the structures that have served it so long. Its new equipment must fit it for life in the air and sunlight. This transformation the cicada accomplishes in one or two hours, depending largely upon the warmth of the night. If it is cold, the metamorphic processes are retarded or altogether stopped. The insect climbs up a plant about one or two feet or, if its host is crowded, perhaps as much as ten or fifteen feet, until it finds a suitable resting place for its last coat of mail. It often shifts back and forth and rolls its body around for from ten to 20 minutes in an endeavor to anchor its claws deep into the bark. It must attach itself securely for this final process, for if its hold is broken after the skin begins to open it will end its life a deformed individual or may be completely imprisoned and killed by the drying shell it is trying to cast off. This does happen

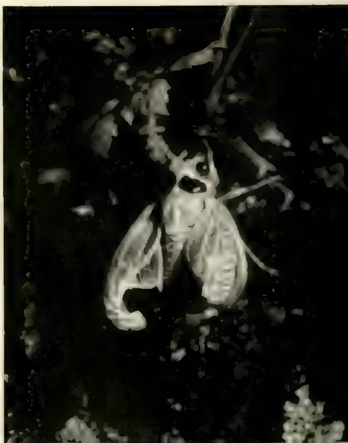


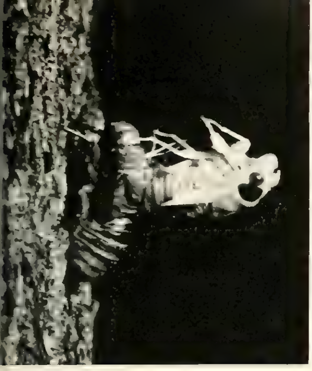
THESE VIEWS from the side show how the cicada begins to free itself by drawing upward and outward and humping its back. Head, wings, and legs have here made their appearance. The insect is preparing for the final struggle for freedom

JUST AFTER EMERGING from its armor, the creature often moves about erratically for a short while

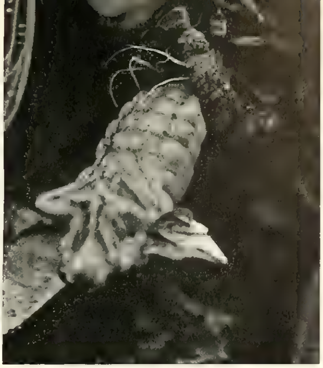
THEN it anchors itself firmly again and seems literally to pump fluid and air into its stubby wing pads

THE WING PADS EXPAND as the onlooker watches them. Gradually the creature that has passed almost seven-





SUDDENLY the cicada becomes furiously active. Clawing the air, it grasps the sides of the shell and pulls free



ITS breathing tube linings (visible above as threadlike objects) are pulled out of the holes along the abdomen

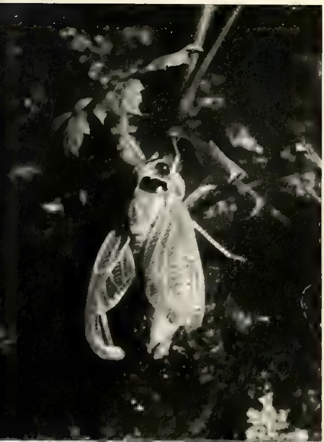
to many cicadas, especially if the atmosphere is dry and hot.

So abruptly that its beginning may be missed, the outer skin suddenly parts in a line down the back, first in the thoracic region, then proceeding forward to the head and backward part way down the mid-line of the abdomen, revealing a snow-white animal within a dark brown casing. The moment the skin starts to shed it is no longer part of the living animal and must be discarded quickly. When the fissure has opened wide enough, as the "profile" photographs show, the cicada begins to free itself by humping its back and drawing upward and outward. First the back of the thoracic region comes out, then in rapid succession the head, wings, and legs. The lining of its tracheae or breathing tubes are also cast off.

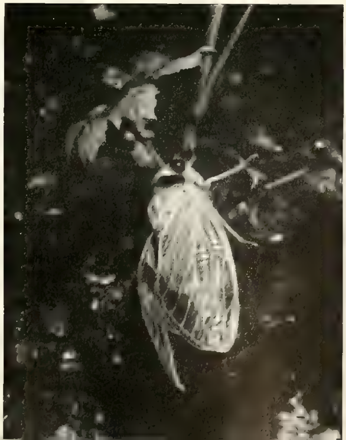
When the inner animal seems about ready to leave its shell, it suddenly bends back at a sharp angle, almost as if it were going to fall over backward, and often remains in this position for as much as 20 minutes. Sometimes it is very still and at other times its body pulsates and rotates. After remaining in this apparently awkward position for some time, the insect suddenly becomes furiously active. Its legs seem to claw the air, and it bends forward and backward several times; finally, as if by a supreme effort, it pulls itself upward far enough for the legs to clasp the sides of the nymphal shell and pull itself free. After this it often moves around in an erratic manner for a short while, and then it anchors itself again and seems literally to pump fluid and air into its stubby wing pads until at last they become fully expanded organs of flight. The cicada is still snow white, save for its pigmented eyes and two large dark spots in the thoracic region, and it does not take on its characteristic reddish-brown color until the coming of the warmth and sunlight of the following morning.

A few days after the appearance of the first adult cicadas, mating takes place, and woodlands and parks vibrate with the high-pitched din of the males. Strangely enough the females are mute. The sound of the male cicada is a high-pitched whirring sound halfway between a whistle and a siren and quite distinct from the more rasping call of the harvest fly or dog-day cicada which occurs later in the season. It has been aptly described as saying "pha-a-a-a-roh," and those who have heard it are not likely to confuse it with any other woodland sound. Shortly after the orchestral din is in full sway, the females commence to lay eggs. This is accomplished by cutting deep gashes in woody tissues with the ovipositor, the egg-laying equipment of the female, and it is from this that the damage occurs. The eggs hatch in late July and August, and tiny white nymphs wiggle out of the bark and drop to earth, often from great heights, to burrow deep into the soil that will hold them until some warm spring night seventeen years in the future.

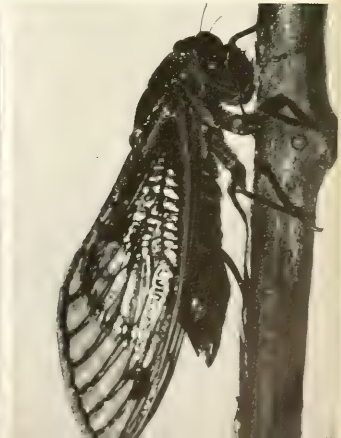
teen years underground becomes equipped with flying apparatus for its brief aerial existence



THE CICADA is still snow white, except for its pigmented eyes and two large dark spots back of them



FOR a generation 17 years hence: a female depositing her eggs during her short life in the world we know



BIG FOR HIS DAY

Bone No. 4666 turned out to be the shank of a brand new dinosaur, greatest predator of his time and equal in ferocity to *Tyrannosaurus rex* though he preceded this famous monster by 65 million years

By GRACE ERNESTINE RAY

Two Oklahoma cattlemen went out eight years ago to wrangle some horses that had strayed and they found something which eventually resulted in the rounding up of a petrified flesh-eating monster that was new to science. Here is the story of that extraordinary roundup which took place under the guidance of Dr. J. W. Stovall, paleontologist.

While squatting by the roadside on their high-heeled cowboy boots and watching the road-working crew on Highway 64, Pard Collins and Truman Tucker suddenly saw things which surpassed their wildest imaginings of what lies below the surface of the ground. A huge curved bone resembling a giant rib about seven feet long and one foot in circumference was turned up by the wide blade of the grader. Mr. Collins shouted, and the driver stopped the machine. The workmen and cattlemen inspected the grim apparition, with the comforting thought that they could not all be experiencing the same hallucination at the same time. They hastily scratched around for more bones and were rewarded with eye-filling discoveries, including fossilized toes about nine inches long. They concluded that they had found the "grave" of some prehistoric animal. They knew it was a *big* discovery from the standpoint of physical size, if nothing else.

Now at that time these ranchmen had not had the advantage of the popular motion picture, *Fantasia*, with its mixture of classical music, art, science, and humor, in which the horrible flesh-eating monster in Stravinski's *Spring* slays and eats a peaceful monster much larger than itself. But these cattlemen read the newspapers regularly so they had at least heard about the prehistoric animals that roamed this region millions of years before the time of the thundering herds of buffalo and the Indian tribes. In fact, Mr. Collins had a habit of wandering through the hills looking for fossils and had previously found several locations, although nothing strikingly important. A typical old-timer of the West, he lifted his ten-gallon hat and scratched his head thoughtfully as the spring breezes played against his brown, wind-bitten face.

"Let's write Stovall—that bone-digger in the University at Norman," he suggested.

"Okay," Mr. Tucker agreed.

In traditional cowboy dialect, these cattlemen did not "savvy" what the bones were, but they were shrewd enough to know they might be rare, and they

(Left) **Excavating a new dinosaur, *Saurophagus maximus,* who once roamed the region of Oklahoma's Panhandle and who upsets previous scientific ideas about the antiquity of huge carnivores**

(Above) **Doctor Stovall, putting the finishing touches on a *Saurophagus* foreclaw. This lethal weapon is even larger than that of *Tyrannosaurus rex,* who came 65 million years later**

were public-spirited enough to call in a museum expert instead of taking possession of their discoveries and trying to sell them as mere curios.

Doctor Stovall, with a scientist's curiosity and elation, could not wait for a week end, but placed an assistant in charge of his classes, jumped into his professorial flivver, and chugged out to the Panhandle the very next day. He took with him Mr. L. I. Price, then a student, who is now associated with the Harvard Museum of Zoology. The site of the discovery was near Kenton in Cimarron County, in that narrow strip of Oklahoma which was known as "No-Man's Land" in the Territorial days and was nicknamed the Panhandle because of its shape.

Doctor Stovall arrived quickly enough, and the hastiest inspection indicated presence of dinosaur specimens packed away in the Morrison shale, a rock formation dating from 150 to 120 million years ago and identified with the Jurassic period.

No wonder Doctor Stovall was all keyed up when he hurried back to his classrooms, even though he knew that the removal of the huge remains intact would not be as simple a job as spring plowing or branding a crop of calves. He immediately applied for federal funds from the Works Progress Administration to excavate the site, and his request was granted. A crew was put to work under his supervision. This was in 1934, and the work proceeded through the months.

Never absent from the site for any great length of time, Doctor Stovall was properly thrilled one day when he checked up and found that his colossal bone yard had yielded specimens of four known kinds of dinosaurs, including the gigantic "Thunder Lizard," *Brontosaurus,* of whom readers of NATURAL HISTORY have already read.* Like a massive petrified tree trunk, the femur or "thigh" of the giant lizard was as tall as the tallest six-foot Westerner when they stood it on end beside the Cimarron pit, and the animal was estimated to be 65 feet long. The other three known kinds of dinosaurs found in this pit were the *Ceratosaurus, Camptosaurus,* and *Stegosaurus.*

These WPA employees, contrary to the proverbial saying, wasted no time leaning on their shovels, but

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**See also* R. T. Bird, "Thunder in His Footsteps," NATURAL HISTORY, May, 1939, p. 254; "A Dinosaur Walks into the Museum," *ibid.*, February, 1941, p. 74.

[illegible] prehistoric times. Much skill is required to excavate all around and beneath a huge block of rock containing the bones of a monster, make plaster of Paris protections for it, and remove the entire block. Week after week and month after month the project continued. Once it was discontinued for a year, but was begun again. All the bones and bone fragments were numbered, and it later proved that more than 3500 of the bones were identifiable. Apparently all the animals had lived in the region of a swampy lagoon, in a warm, moist climate, and when old age or disease crept upon them, they sought the company of their fellows on the shores of marshy lakes at their favorite feeding grounds. There they died in great numbers, and petrification took place where they lay.

One morning while visiting the site and poking among the excavated specimens, Doctor Stovall found some bones that were not familiar to him. Of course, to a layman it would be hard to find any prehistoric bone that *was* familiar, but the paleontologist seldom sees a vertebrate bone that he does not recognize as an old friend.

"What's this thing?" he asked that morning as he picked up a hefty long shank numbered 4666. He suspected that it did not fit into the skeleton of any known dinosaur. It was heavier and stockier in proportion to its length than any of the familiar brands of old-style dinosaurs already removed from the pit.

"I had no hope at first that this would prove to be a new kind of dinosaur," Doctor Stovall modestly relates. However, a greater surprise was in store for him. As he personally dug around in the pit where the strange bones had been found, he unearthed a wicked-looking claw. He saw that it was the claw of a forefoot or hand about a foot long, much bigger than those of the known flesh-eaters of the Jurassic period. Of course, he knew that the herb-eaters did not have such claws.

He collected all he could find of the unfamiliar bones, but his diligent searches revealed mainly dissociated bones, scattered about among the familiar bones of the known dinosaurs. Fortunately very few of the bones were broken. Still doubtful about the identity of his strange bones, Doctor Stovall shipped them all to Norman, went home, and then began the detailed process of measurement and comparison of the unidentified bones with the bones of dinosaurs already known. The strange bones proved to be the wrong shape and too small for the herb-eating varieties of Jurassic dinosaurs. And they were too large for the hitherto known small carnivores of that period, yet they had the characteristics of the flesh-eater. In size they reminded him of the horrible-looking *Tyrannosaurus rex* of the later Cretaceous period, yet there were very important differences.

More study and research followed, and finally Doctor Stovall knew without doubt that he had discovered a new kind of dinosaur—a genus that no [illegible] had ever found before! In instances such as this, no christening ceremony is held, but a new creature, even though it is only an inanimate dinosaur, must have a name—one can't simply go on indefinitely calling it "It." So the new dinosaur was named *Saurophagus maximus*.

The significance of this new discovery is that prior to this time it had been supposed that the *big*, tough and ugly flesh-eating dinosaurs appeared on earth much later—about 65 million years after Doctor Stovall's geologic debutante made its appearance in the Jurassic period. Some *smaller* tough and ugly beasts such as *Allosaurus* had already been found in the Jurassic period, but the largest of these was 29 feet long—small when compared with Doctor Stovall's big-clawed dinosaur, which measures 42 feet.

In other words, it is the first dinosaur of its kind found anywhere on earth. Doctor Stovall found the bones of two fairly complete specimens, and they are now being prepared for exhibit in the University of Oklahoma Paleontology Museum at Norman. This is easier said than done, for many weary months are required to clean all extraneous rock from the specimens, without chipping the fossils themselves. Camel's hair brushes are used, although it seems incongruous that such a delicate tool is needed to work on such colossal skeletons.

In what respects does the *Saurophagus* differ from the smaller carnivores of the Jurassic period? In total size, principally, of course, but the hands and arms are much larger, and the arrangement of the metatarsals is less specialized in that they are well separated and have no overlap. In what ways does this large-clawed dinosaur differ from *Tyrannosaurus rex*, the terrible flesh-eater that stalked about as the king animal of prey about 65 million years later in the Cretaceous period? The *Saurophagus* was much more massive in proportion to its height, and it had arms more than twice as long as the *rex*, because it had not evolved as far away from the dinosaurs that walked on four legs. Which one was more terrible, more destructive to contemporaneous animals in his prehistoric wilderness? That question is difficult to answer. Perhaps it is a toss-up. Both dined regularly off the neighbors.

To make more realistic his stack of fossilized bones, Doctor Stovall has reconstructed his idea of the new genus as follows: *Saurophagus*, measuring 42 feet from teeth to tail and boasting a height of 16 feet when standing erect, had a bulk which equaled that of a *small* house, or perhaps Paul Bunyan's bull! And when you imagine an animal as big as a house with sharp front claws eleven inches long and a mouth that opened to a width of four feet, displaying numerous saw-bladed teeth six inches long, you have reason to be glad that your appearance on earth was postponed to the Recent geologic period.

The joints of this dinosaur were close-fitting, indicating an active creature, although a modern lion could probably have run circles around him. Evidently he had the power to leap upon and bring down sluggish herb-eating animals much larger than himself, although Doctor Stovall personally doubts that his new dinosaur lunched on creatures *almost twice* his size—doubts even that the popular theory that the *Tyrannosaurus rex* performed such feats.

"Any creature, even a silly dinosaur, would use some caution and judgment about picking a fight," Doctor Stovall remarked with a smile.

Despite his strength and power and his technique in terrorizing the enemy, *Saurophagus* would never have been able to pass the medical test of a military draft board, neither would Mrs. *Saurophagus* have qualified as a "perfect 36." They were hopelessly overweight, and it is improbable that any amount of dieting would have remedied the situation. Overactive glands may account for their stupendous size, as in the case of other dinosaurs.

Be that as it may, *Saurophagus'* powerful forelegs and eleven-inch claws distinguish him as the most predaciously developed dinosaur of his day, and it is even possible that, weight for weight, he may have been a more terrible fighter than the celebrated *Tyrannosaurus rex*, who came much later.

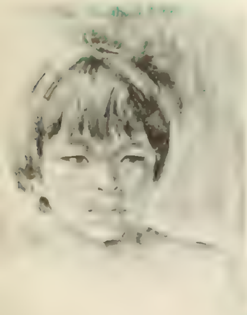
Inspecting the pit where *Saurophagus* was found. Preliminary studies reveal its length to have been 42 feet. When standing erect the creature was 16 feet tall, and its mouth opened to a width of four feet

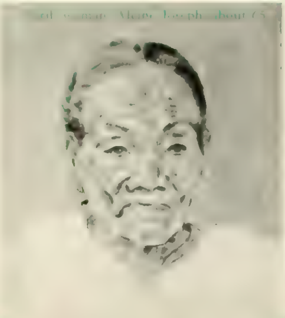
A CARIB COVE: picturesque Salybia Bay on the British island of Dominica in the Lesser Antilles, showing the boulder-strewn strand where fishing boats are beached through rough surf

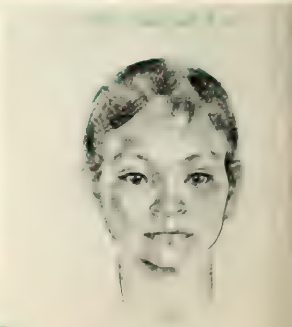
ON SUNDAY, November 3, 1493, Columbus and his followers made the first landfall, after leaving the Canaries, in their second voyage to the New World. Almost simultaneously, four islands hove into sight. The loftiest he called Dominica, in honor of the day; the others were named for his ship, the *Marie Galante*, for the Spanish monastery, Our Lady of Guadeloupe, and, to mark the attainment of their desired goal, la Desirada.

On the following days, he and his crew made contact with some of the inhabitants—the second group of "American Indians" to become known to history. Those encountered on the first voyage, the Taino of Haiti, had already told Columbus about these warring "Cariphúna" (from which our words Carib and cannibal have been derived), who by advancing through the Lesser Antilles had at that time occupied the most easterly part of their island.

Again it is Sunday, November 3, and now, from the only spot where a single native "Indian" may yet be found in the entire island chain from Florida to the delta of the Orinoco, I am looking out across the timeless Atlantic where Spanish ships were spied just 447 years ago by some long-forgotten ancestor of the men and women around me here today. For there are still Caribs on Dominica,—though they and their Taino foes have long been extinct in the other islands. Here, in the last Carib Reserve, the records of bygone days are enhanced by many living traits. It is not hard to retrace the centuries in imagination and reconstruct a scene we might well have witnessed, had we, as unobtrusive strangers,







COLUMBUS SAW THEM FIRST

They were an energetic race then, and powerful—our words "cannibal" and "canoe" stem from their language—but today the few remaining Carib Indians are a doomed people, soon to add the bones of their culture to the fast mounting heap left in the wake of civilization

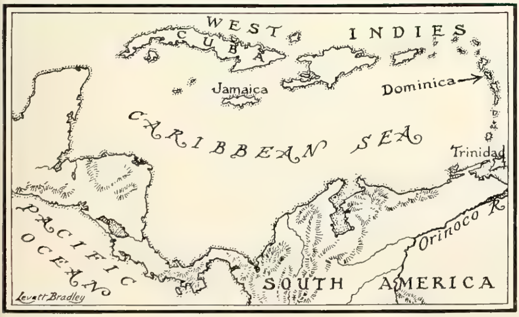
By DOUGLAS TAYLOR
With drawings by HESTER MERWIN

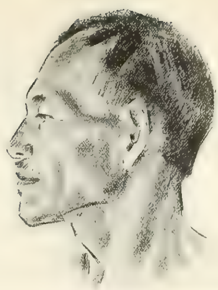
visited this coastal strip in the days before the Conquest.

Then as now, we might have followed a tortuous path worn in the red volcanic clay of a hillside or in the rich black loam of decayed vegetation. On either hand great hardwood trees, whose gnarled roots provide steppingstones in the dank mire or a stairway on steep declivities, rise 100 feet into the moisture-laden air, their evergreen foliage forming a dense screen from the blazing noonday sky. Far overhead in an ungainly flight, parrots whir and scream their Carib name, *"cooriwhek, cooriwhek!"* While from some hidden branch or dark gully the mournful, reiterating notes of a mountain whistler *(Myiadestes* sp.) or the unearthly coo of a native dove put the lone traveler in mind of the spirits of the forest.

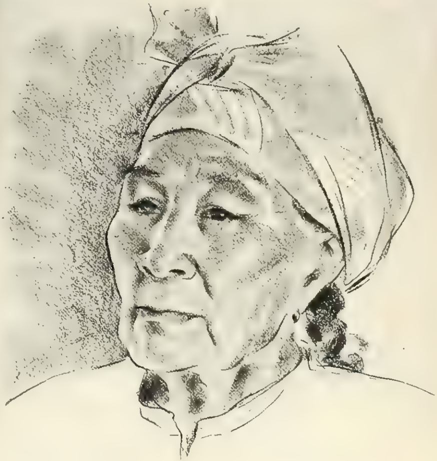
There is little else to break the heavy silence. The island's only two native mammals are not in evidence: the *manicou* (a native opossum) is asleep in his nest in the treetops, and the agouti *(Dasyprocta aguti)* is hidden safely from all but a dog's nose. True, we might meet with a hunter advancing

(Below) DOMINICA is the last refuge of the Caribs

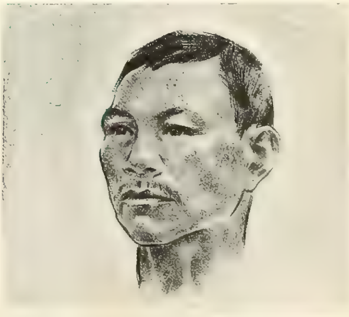




"JOLLY JOHN," Chief of the Caribs until his death several weeks ago



(Above) MIMI ETIENNE, a descendant of the Indians who greeted Columbus in 1493. *(Below)* A young Carib whose face typifies his race



[illegible] much of what the forest meant to the [illegible] of catching [illegible] alive by stupefying them with the fumes of burning pimentos, of "honey-trees" where the tiny stingless native bees deposit their aromatic syrup in pockets of black wax. But more likely that native hunter would have sought to instruct us by telling of strange "precautions"—charms practiced on man and dogs and restrictions to be observed before, during, and after the hunt—rules a man must know before he can hope to become a successful hunter.

The Carib has always preferred the danger of the sea or the mystery of the forest to the monotonous labor of planting, weeding, and gathering. Most of such work he has left to the women.

Here and there in our walk we may chance upon the stout bole of a centenarian ***gommier (Dacryodes hexandra*** Gr.) lying hewn in the graceful form of a dugout canoe between its fired stump and severed head, waiting, amid a heap of chips, to be hauled with gaiety and song to the coast, there to be further shaped and fitted for a new and roving life.

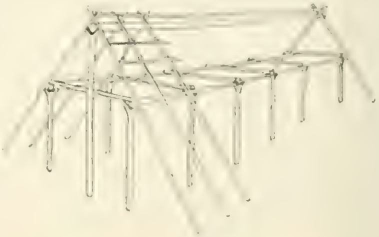
We would find clearings, too, where charred stumps and rotting logs stood out blackly in the yellow sunlight amid a purply green field of manioc. To such clearings, felled and burned by the men, the women came to plant or weed. They trudged back to the coast in the evening, their loads of manioc or sweet potatoes, pumpkin or corn, slung from their foreheads in long, narrow knapsacks of woven palm roots.

Thus the Carib's life was, and largely still is, patterned by three elements: the "high woods," in which game is becoming scarce and difficult to get as the tall trees retreat before the woodsman's ax; the "gardens," which are still cultivated by the primitive system of burning the soil and which must follow the forest inland, leaving behind an impenetrable waste of tangled weeds; and lastly, the sea, which bore the Caribs, like others before and after them, to these shores.

On the last mountain ridge the trade wind hits us full in the face with a refreshing tang of salt and ozone. Two thousand feet below, the Atlantic spreads glitering eastward, and toward the northeast the shadowy trapezoid form of Marie-Galante bars the horizon. In deeply wooded valleys and ravines between the headlands, run clear, crayfish-filled brooks that may, after heavy rain, "come down" as raging and impassable torrents.

Two essential considerations have ever governed the Caribs' choice of a site for their dwellings: the proximity of running water for bathing and drinking; and a view of the sea, their only highway. The Caribs are sailors by tradition as well as by taste, and it is interesting to note that we get our word "canoe" not from the birchbark craft of the Indian but from the Carib ***kanawa***, a dugout, whose length —believe it or not—was upward of 60 feet. Its sides were raised by the addition of planks, and it was about eight feet wide in the middle. This 60-foot [illegible] carried two masts each supporting one sail and could accommodate [illegible] men at the paddles. The other type of dugout used by the old Caribs was, and still is, a smaller craft of similar construction. This type of canoe was used for fishing and short journeys. The ones made today range in length from fifteen to 30 feet, 20 feet being the most usual size.

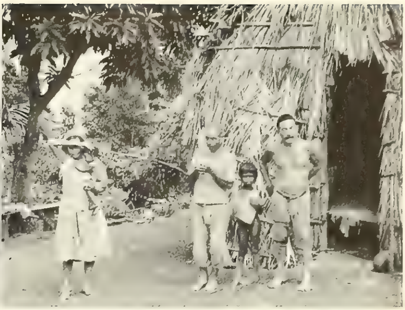
In the old Carib settlement a central long house, or *tabwi*, built near the mouth of a valley, formed the nucleus of what was usually no more than an extended family group. This building, which attained upward of 24 by 60 feet, served as armory, men's club, and bachelor's residence, and was usually supplemented by a guesthouse of similar construction but smaller. Two stout forked posts stuck in the ground supported the ridgepole. On either side of these came a row of smaller forks supporting a wall plate that ran the length of the house. Upon the latter rested a series of tiebeams from which the hammocks were slung. Over this framework came the long rafters, which went into the ground and crossed above the ridgepole, where they were held in place by a slighter pole resting above the crossing.



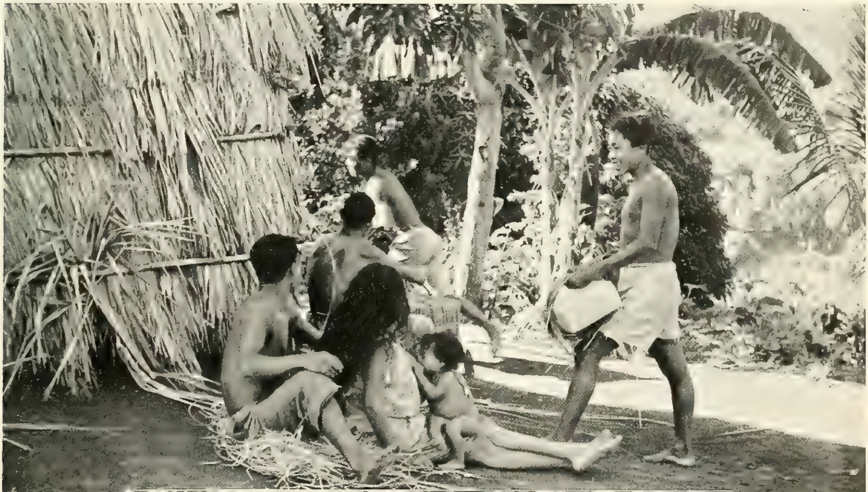
The individual houses, or ***mwinã***, rarely measured more than fifteen feet by twelve feet and were of simpler construction. They were dispersed, at the owners' fancy, at various heights on either side of the valley. Each had a courtyard of beaten mud and a surrounding fringe of vegetation where such domestic plants as cotton, calabash, annatto, and herbs of medicinal or magical virtue formed a screen that hid the house and its occupants from the gaze of the indiscreet stranger.

Had we arrived in the evening, when men and women were home from their various occupations, we should have been welcomed by the one whose duty it was to receive strangers. We should have been led to the guesthouse and served with cassava-bread, ***túmali*** (pepper and manioc-water sauce), sákuti (a manioc beer), and whatever meat or fish, fresh or barbecued, was on hand, set before us on little basketwork tables. We should have drunk out of a half calabash that might have been lacquered and decorated with such designs as cross-hatching, Greek key, diamonds or crosses. We should have sat on long low stools carved out of a single piece of wood. Only when we had finished eating would the Chief and elders come to greet us individually, and in order of precedence. Their greeting would have been a pat on the shoulder and a "***mabwika!***" which has about as much significance as our "how do you do?"

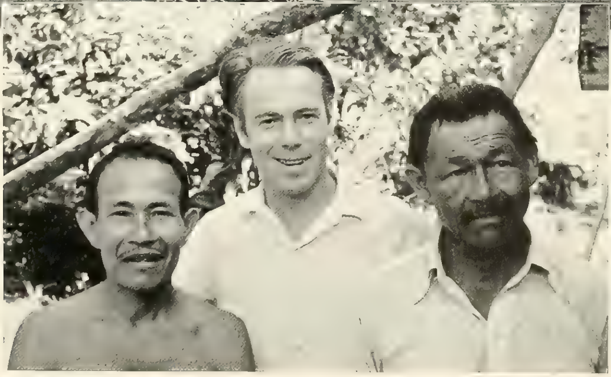
A scene showing the vegetation along the coast of Dominica



A Carib family before their typical thatched dwelling



A Carib family, representative of the only native "Indians" that can be found in the entire island chain from Florida to the Orinoco



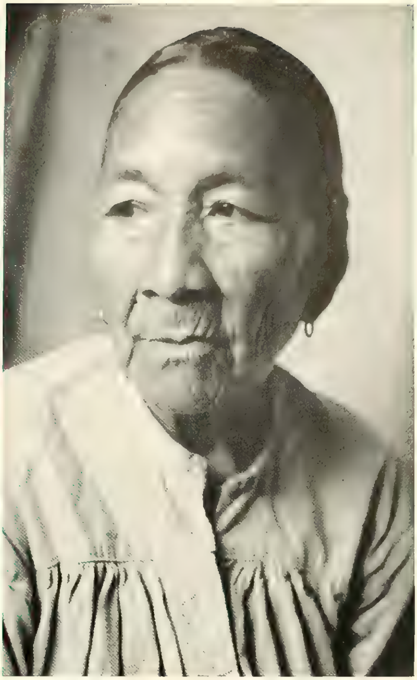
(*Left*) Douglas Taylor, the author, standing between "Jolly John," the chief who recently died, and Jimmy Benjamin

All photos by H. M and E. L. Ayers

A DUGOUT CANOE, being stretched amidships by water and stones. The Caribs gave us our word "canoe" and distinguished themselves in the building of enormous dugouts 60 feet in length. *(Above)* Abraham John, age 12

(Below) **A DEVOTEE of the traditional arts: a native making mahoe sail cordage. The Caribs were one of the few groups who had developed the use of the sail before the coming of white men to the New World**

A **Carib youth** who, like three out of every four in the last remaining Carib refuge, is of mixed descent



The older Caribs decry mixed marriages, but the younger ones feel no compunction. *(Above)* Mimi Etienne

All photos by H. M. and E. L. Ayers

(Below) **Elwin Lucien** (age 45) and child, seated beside his hut

[illegible] no surprise. The islanders, like their kindred on the mainland, were mostly sturdy men of rather short, stocky build, with Mongoloid features, straight black hair cut in a fringe across the forehead, and light reddish-tan complexion. Used only to a climate [illegible] useful purpose, the Caribs' principle covering consisted of a coat of vermilion paint composed of crabwood oil and annatto, and reputed to prevent sunburn and insect bites.

Two languages in each family

What perhaps would have struck us first was that the men and women did not speak the same language. We would have been told, had we inquired, that the Caribs' forefathers were a branch of the mainland Galibi. Driven from their lands, they had set sail under the leadership of a small though indomitable chief. They had landed in these islands where, after killing the native warriors, they had taken their women to wife. Since that time, their daughters had preserved something of their mothers' tongue.

The Caribs believe that a mother endows her child with its body, while the father's contribution is its spirit. This belief may explain two ancient and widespread American Indian practices known as the "couvade" and "cross-cousin marriage." When a man got his first-born son, he took to his hammock, abstained from all food for five days and thereafter fasted partially for a further period. Even today the young Carib observes certain restrictions intended to safeguard the welfare of his newborn child.

Unless he were a chief, the newly married man went to live in the home of his bride's parents, who, because of the custom known as cross-cousin marriage, were often his own paternal aunt and her husband. Here he passed a sort of probationary period of one or two years, hunting, fishing, and clearing gardens for his father-in-law. His wife followed the usual household routine of fetching wood and water, baking cassava and brewing manioc beer, weaving hammocks, bands and loincloths, and going to the beach to carry home her husband's catch.

After this period, if all went well, they usually made a home of their own. If they should not agree, the man returned to his father's home, while any children remained with their mother.

Although there was a chief in each settlement and one, or sometimes two, supreme chiefs for the island as a whole, their authority was not conspicuous. These chiefs used neither titles nor insignia. They were chosen from among the elders to play the role of paternal arbiter because of superior knowledge or endurance rather than for wealth or family. In wartime, special leaders were chosen to command forces and fleets and these had to be obeyed throughout the expedition. But in peace, within the family, as within the tribe, commands were practically unknown, and the only sanctions were those of personal or family vendettas.

Usually a quiet, gentle, and easy-going people, the Caribs are given to nursing their wrongs in fits of melancholy and to unreasonable caprice, which under the influence of drink may develop into violent rage. In the old days such was often the origin of murder or even of a war raid. Luckily, these fits were quickly spent. We are told that those prisoners who escaped the first violence of the Caribs' anger were brought home and treated by their captors as their own people. The first missionary fathers to come to Dominica in the seventeenth and eighteenth centuries also relate that the Negro slaves acquired by the Dominica Caribs were much more gently treated than by the run of white masters. In fact, these French fathers —Du Tertre, Rochefort, Breton, Labat—despite their almost total failure to make proselytes, gave the islanders a very good name. Although they deplored their laziness and indifference in matters of religion and acculturation, Breton, who spent 20 years among the Caribs in Dominica (first settled by whites in 1760) declared them to be hospitable, polite, honest, and truthful, adding that "be it said to their glory and to the confusion of Christians, they never behave publicly in an immodest manner."

Few legends have withstood misplaced missionary zeal and the general breaking up of Island Carib culture. What little survives points to a common origin with that of the Guayana tribes. Several tales current in Dominica mention a giant snake that can crow like a cock and in whose head a stone of dazzling brilliance is set. The old Caribs relate how this creature would appear in human shape to their wise men, helping, advising, endowing them with charms, and even on occasion begetting the early progenitors of their nation. One of the latter, Bakámõ by name, had, they say, the body of a snake with a man's head; he was carried out to sea where he became the constellation of that name (our Scorpio). Other stories identify other constellations and heavenly bodies with early culture heroes, but never as objects of worship.

Medicine men

There existed a class of men called *bwayé*, or *piayé*, who, in order to become "wise," submitted to a severe and often painful apprenticeship, which enabled them to fulfill the role of doctor, priest and sorcerer. They acquired from their masters one or more familiar spirits, which they evoked by incantations and offerings whenever the need for consultation arose. I have spoken to old Caribs who remember such séances. They tell me that offerings of cassava and rum* were placed on tables on one end of the *mwinã,* which was completely darkened. The *bwayé* would sing and mutter, until the spirit "fell in" with a thump. The spirits spoke in strange voices, and "you could not tell what they were saying, but you could hear the 'glou-glou' sound as they drank the rum." When the house was re-opened, the offerings appeared to be intact and were consumed "early in the morning before eating" by those who so desired. The spirits, I was told, consumed "only the soul of the offerings."

Like their kindred in Guayana, the Island Carib still believes that the woods, rivers, and sea are the homes of particular kinds of spirits. On occasion, these may show themselves in a benevolent light, but their appearance is more often of evil omen to man.

Trade

No doubt even before the coming of white men a barter went on between the mainland and the islands. Crescent-shaped ornaments of a gold alloy called *carácuri,* green stone charms, and no doubt certain raw materials and products made of them must have been acquired from the mainland either by war or in exchange for something, perhaps canoes, that the islanders made with greater facility. But all in all, each island and even each settlement in the island was independent of others for their everyday needs. Hardwood was varied and abundant for all purposes, but iron and bronze were unknown, and stone-cutting implements such as axes, adzes, and knives were tedious both to make and to use. For that reason fire was often used to fell a big tree. Nevertheless the Caribs, or their Taino predecessors, used to manufacture by primitive means and through months of labor not only weapons and tools, but also pierced cylindrical beads and carved figures of stone. Whenever possible, the Carib made use of natural objects: thus, his fishhooks were usually a kind of thorn, his arrow points of wood or reed hardened by fire, his scalpel, the pointed tooth of an agouti set in a leg bone of the same animal. Fishbones provided him with needles, necklaces, and boring instruments. The women made some pottery when suitable clay was at hand, and calabashes of all shapes and sizes provided the kitchen with a varied array of buckets, pans and dishes, boxes and bottles.

Meat and fish are roasted directly in the fire, or smoke-dried on a wooden grill over it. The basis of the Carib diet is manioc. Because the tuber of this plant contains a cyanic poison, it has to be rendered harmless by fire before it can be eaten. Without necessarily crediting the Carib with the original discovery, we must marvel that a plant which is poisonous to eat should have been made edible by a process so complex. The tubers are peeled, washed, and then grated into a vessel rather like a small, six-foot dugout canoe. The resulting pulp is next squeezed in a long, stocking-like contraption of close-woven basketry, called *matapi.* Then it is sifted through a basketwork sieve, or *hebichet,* and finally baked on a stone slab either into thick, round cakes of cassava-bread, or by constant stirring, into a coarse meal. The water squeezed out of it soon deposits a fine starch, which may be added to the meal or used separately. As for the remaining manioc water, it can be boiled together with pimento and other seasoning to form what is known to the present-day Creole as pepper pot or cassareep, and to the Carib as *túmali* or *syúti.* After being sufficiently boiled, the manioc water is reduced to a thick brown sauce, which has the quality of preserving any meat cooked in it. For drink, certain thick cassava cakes were formerly chewed by the maidens and spat into a vessel containing water. After a few days' fermentation, this mess was strained and drunk under the name of *ouíku* or *sákuti.*

Apart from their household duties, the women looked after the gardens, collected fruits and berries, made crabwood oil and paint, decorated pots and calabashes, painted the men, spun cotton, and wove hammocks. The hammocks sometimes attained twelve or fourteen feet in width and were closely woven on a simple frame without—according to Breton—either heddles or shed-stick!

Besides hunting, fishing, and clearing land for gardens, the men made dugout canoes, paddles, sails, and fishing line from a species of bromelia, together with the axes and adzes used in their making. They carved war clubs, stools, bowls, and cassava troughs out of red or yellow hardwoods. The same sort of war clubs are used nowadays for killing fish, and are called by the same name, *bútu.* Besides this the men made most of the basketry and other utensils used by the women. It is small wonder that they had but little conception of the passage of time and the value of strange articles.

Outside influences on the Carib

Although contacts between Carib and European or Carib and Negro must have been few and far

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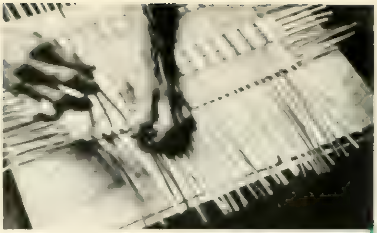
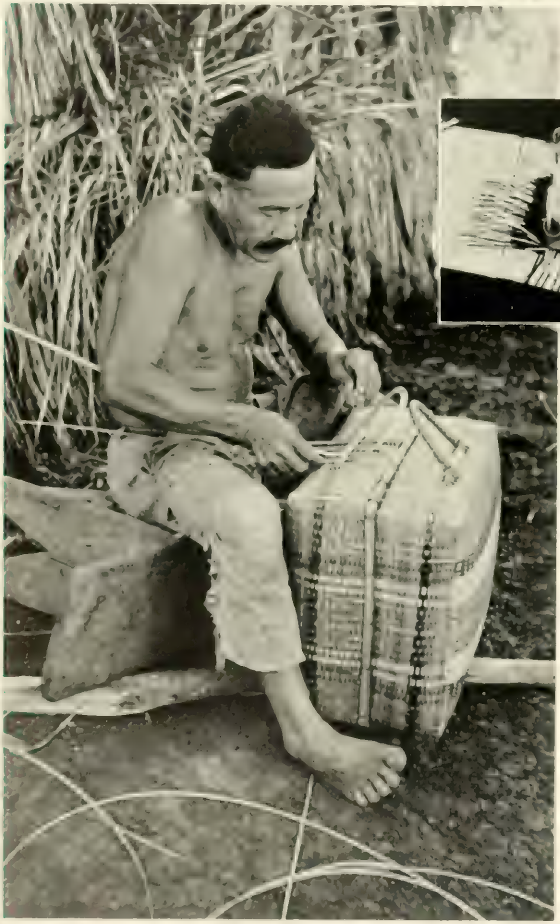
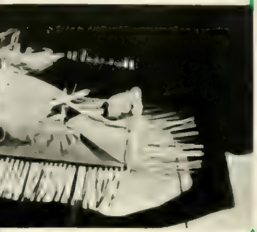
*Introduced by white men. In earlier years native beers were used.

A NATIVE weaving the outer layer of a waterproof basket



A CLOSE-UP of the weaving shows artistic workmanship





A BANANA LEAF lining goes between the inner and outer basket covering

THE COMPLETED BASKET, fitted with handles, is a useful object of trade between at first, acculturation began at an early date, as is shown by the "Caribized" words of Spanish origin included in Father Breton's dictionary of 1665. There were at that date Caribized words for horses, cows, pigs, goats, and rats, guns, knives, nails, needles, plates, iron and silver. The words for clothes, hats, shoes, and smallpox had also been adopted into the Carib's idiom, and it seems probable that the things they stood for, despite inborn conservatism, had influenced his culture to some extent.

As long as the Carib had to depend upon his own efforts to produce not only food and housing, but also his tools and weapons, utensils and ornaments, he maintained through tradition and invention a relatively high standard, which doubtless would have improved as time went on. But when he was confronted with the products of a technique far beyond his comprehension and ability, a technique which included guns and steel axes, he naturally abandoned his native crafts, to devote himself more and more to the production of articles for exchange or sale. Unfortunately, most of his products had little value to the Europeans except as curiosities; and so the more he produced, the less he received in exchange. When he was unable to improve his technique,—and this usually was the case—, the Carib could only lower the quality of his work. Moreover, not all of the European products that appealed to the Carib were as useful to him as guns and steel axes. The labor expended for the purchase of clothes, hats, shoes, rum and so on was simply lost, because these things replaced nothing in his old economy. Time hitherto devoted either directly or indirectly to the production of food or comfort was henceforth used, for example, in cutting timber and building canoes to sell to the white man. This process, which is not yet complete, has led on the one hand to a lamentable deforestation, paucity of game, and impoverishment of the soil; and on the other hand, it has led to frequent visits to the town, from which the Carib returns without anything to show for selling his canoe except a sick headache, or at best, some gimcrack and useless product of "the export trade." I had almost reversed the order, and said, "at best a sick headache," for the Indian thoroughly enjoys getting drunk, while the more solid goods hoisted upon him merely delude his misguided vanity.

The retreat before civilization

Innate shyness and conservatism as much as European musketry drove the Carib to the more rugged isles, and in them to the least accessible parts of the windward coast. After the last of their number in St. Vincent had perished in the volcanic eruption of 1902, Dominica remained the red man's sole island of refuge.

By that time, bows, arrows, hammocks, and native pottery were forgotten, and had been replaced (among those who could afford them!) by guns, beds, and cheap crockery; but the Caribs' voluntary isolation, coupled with their paltry commercial value and hard-dying reputation as "dangerous savages," ensured them a relative independence that since then is slowly being broken down by the incursion of Negroes.

It is in the past 40 years that this small group has suffered what is perhaps its greatest loss of integrity—its language, or languages. Doubtless to some extent mutually corrupted, these two idioms subsisted side by side until about the end of the first decade of this century. Both succumbed before the French Creole patois of the West Indian Negro and "colored man." Even today, when their memories of what they laconically term "the language" are jogged, old men and old women of the Reserve still often give different words for the same concept. But with the last Carib speakers there doubtless disapeared many cultural links with the past that never can be replaced. The use of a common idiom leads inevitably to a community of notions and mental attitudes. And so it is that the Island Carib of today knows little about his own culture and nothing about our culture except, as it were, through Negro eyes.

Intermarriage

Although the older Caribs sometimes declare that *"mékeru k'hínsi kasi kámukuru"* (Negroes stink like grass gourds), the younger generation feels no compunction at interbreeding. Out of 400 inhabitants of the Reserve today, 300 are at best, as they themselves admit, *"bâtards Caraïbes"* (half-breed Caribs).

The girls no longer take easily to the old ways, and demand, like their colored sisters, hats, shoes, and sewing machines. The boys learn just enough at school to lose interest in the old pursuits, and far too little to have a chance of success at the new ones. Few are those who still take readily to fishing, and fewer still are those who have any skill or liking for the hunt.

Basket making and canoe building of an inferior quality, together with sawing boards and scantlings, continue chiefly because they are usually the only available means of obtaining the money to buy the products of the colored trader. Many still yearn for a roving life, but it is to the plantations and sugar mills of Guadeloupe, Santo Domingo, and Cuba, or to the oil refineries of Curaçao that they aspire, rather than to the rivers and forests of their Guayana forebears.

HIDE AND SQUEAK!

—if you want to get good animal photographs

By H. H. Sheldon

With photographs by the author

NATURALISTS ARE curious eggs. And there are in these United States millions of all types of curiosity. This expanding curiosity regarding Nature and her ways sends into the wilds its volunteer army, superficially trained in wildlife and woods lore, and armed with every type of camera from miniature to movie.

Curiosity and encyclopedic knowledge of the wilds and its creatures are not enough to capture that universally sought rarity, a good bird or animal portrait. If the amateur naturalist is consistently to bring-'em-back-alive on film, he requires not only time, patience, and no small amount of hard work, but an intimate knowledge of the domestic habits of wild animals and birds, plus something more.

That this "something more" is essential to good animal photographs is immediately apparent when one considers the scarcity of real portraits of domestic animals, which are docile and [illegible]. Every home has a picture of its own familiar dog, or cat or cow or horse. But how many of these photographs of pets possess that quality of telling more than the shape and external appearance of the animal? Pictures which portray, in addition, individual characteristics, racial or hereditary instincts, moods, capacities, and vagaries [illegible] can be got.

I have been matching human wits against animal craftiness since I was old enough to shoulder my dad's big ten-gauge duck gun, and that is several decades ago. For 20 years my duties as a field naturalist required (among other things) guns, traps, and labels. A camera was something in the nature of a luxury. But from the moment it became my privilege to discard the guns for the camera, I have discovered there is infinitely more satisfaction and glory in shooting an animal with a lens than in stopping a leaping life by a high-powered bullet. Incidentally, I am not a reformer. Hunting is grand sport, providing a temporary freedom and pleasure to unnumbered millions who have come by the urge to track down and kill through the brave blood of hunting ancestors. But I do believe that, with most of us, a saturation point is reached. And when that time comes the camera ranks as a more potent weapon than the gun, requires a more subtle type of hunting skill, and provides more lasting pleasure. Curiously enough, experience and skill in rifle hunting are fundamental assets in acquiring skill in camera hunting. And of those requirements conducive to that "something more" requisite to animal photography, one of the most important has been brought directly from the sport of hunting with a gun.

(Left) A MULE DEER

This important equipment is in reality a lure. It is used by naturalists the country over to decoy birds and animals within range of either gun or camera. Like most important things, it is so simple as to conceal its own importance from the uninitiated. In the realm of "ologists" it is known as "squeaking": simply a matter of compressing the lips and sucking in at the corner of the mouth. Some of us have perfected it to greater degree than others, not because of anatomical advantages, but by the canny use of imagination.

A naturalist can identify any bird or animal by its song or cry. In addition, he knows which birds and animals prey upon which others. Combining these two sets of facts with a little imagination, he can learn to produce a squeak which will imitate a robin in distress, the squeals of a trapped mouse, or the whimper of a lonesome pup. Cupping the hand at the corner of the mouth controls or amplifies the volume. With a little practice, anyone can become an expert squeaker-upper. Since the day, years ago, when I first beheld this stunt in operation it has been my most potent lure in outsmarting wise old Mother Nature. Deer and hound, hawk and chicken, skunk and house cat—they all fall for it. Birds and animals are as curious as naturalists, and are intrigued by any sounds which do not frighten. I have squeaked the wariest hawks to within a few feet of me, likewise some of the most sensitive and fearful of animals. I have stopped the weasel in his tracks to about-face and sit up like a rabbit almost in my lap; muskrats to turn in midstream and swim right up to my hand; and on the wild deer to pose for me, stamping their feet in exasperation at the sounds of a fake tragedy. I have squeaked the timid ground squirrel from his subterranean haunts to pop up for a three-foot shot; and the badger, like the weasel, becomes a sucker for the squeaks of a rabbit in distress. The handsome skunk is unsuspicious of this sort of lure, and will present his better end for a portrait.

I could go on adding up the times when the squeak has produced salon winners,—but wait. There's a string attached to this squeak. And a literal string, at that! For not all animals are as brazen as the weasel, or as indifferent as the skunk. Nor would a ground squirrel pop up from his burrow if you squeaked him up with camera in hand for a three-foot close-up. But if your camera is set for a three-foot shot, while you and your squeak are hidden behind a bush some 30 feet away, the ground squirrel will be more than apt to surface for a look-see. One did for me. I pulled the string, the shutter clicked, the ground squirrel screamed as he scurried down under faster, it seemed to me, than the 250th of a second at which I shot. But the squeak, string, and shutter were perfectly synchronized, and an interesting photograph was recorded.

At this point those who have not tried it will be tempted to believe a telephoto lens is the thing with which to get good animal portraits. A telephoto lens is a real advantage whenever the subject is in the open for a clear and unobstructed long-range shot. But it cannot see the small, shy animal peering up through high grass, nor the larger animal separated from the camera by thick undergrowth. To catch these, the camera must be near the subject while the photographer and his squeak and string are at a hidden distance.

(Above) AN INTIMATE MOMENT: **mule deer and fawn, taken on Verichrome at 1/100 second and f:6.3**

(Below) A GROUND SQUIRREL **at his hole**

A little ingenuity is required to invent a gadget to release the camera shutter by means of a string or thread. For one, a Contessa Nettel, I have contrived a brass band that is adjustable and can be slipped onto the camera in a few seconds. To this band is riveted a piece of clock spring, also a two-inch strip of brass, which acts as a trigger to release the spring. The string is attached to the trigger. When ready to use, the cable shutter release is removed from the camera; the band is slipped over the camera so that the spring fits over the shutter plunger; the spring is then pulled up and cocked by the trigger. A pull on the string (I use a level silk fish line) releases the spring, which snaps against the plunger and releases the shutter. This may sound a little like a Rube Goldberg design, but actually it is quite simple. Best of all, it works. I have taken photographs from a blind a distance of 150 feet from the camera, though 30 or 40 feet from the camera is more usually the case. Here again, distance from the camera is largely determined by the temperament of the subject, and by the type of country in which one is hunting.

There is no copyright on this hide and squeak method; but if you use it, I am sure you will get pictures you will want to copyright.

One-Man Explorer

Without benefit of base camps and elaborate supply lines, Harry Raven has ventured alone into some of the world's least known jungles. These exploits rank him among the great fieldmen of our time, while his laboratory studies in Comparative Anatomy have brought him international scientific fame

By D. R. Barton

A [illegible] American Museum [illegible] inured to the unexpected and accustomed [illegible] celebrated world-travelers. But even New Yorkers [illegible] entered the restaurant riding a kiddie car.

Quite the tallest person in the room was the chimp's companion, a mild-mannered, unobtrusive gentleman of medium height whose bald head, close-cropped moustache and conservative dress bespoke a professional man, possibly a family physician, certainly the last type on earth Hollywood would cast as an intrepid explorer. Yet Harry Raven had known what it was to lie near death in the African jungle, leagues from the nearest white man, and he had become, for a time at least and in his own fashion, a wild man of Borneo.

But the chimpanzee held the center of the stage. She rode her kiddie-car on into the curators' end of the dining room, where she was ensconced in a high chair and served two helpings of ice cream. It is generally believed that she was the first ape to be accorded quasi-membership on the Museum's Scientific Staff, though some people regard the matter as controversial. At any rate, the curators were unanimously devoted to "Meshie."

Her foster father, Henry C. Raven of the Department of Comparative Anatomy, had brought her back from Africa and raised her with his own children at Baldwin, Long Island, where she delighted in the seasonal occupations of cycling and sleigh-riding, respectively. Raven probably derived a certain faintly malicious satisfaction from the momentary disruption [illegible] *kiddie-car* never failed to produce, for his earlier experience with museum restaurants had been something of a disappointment.

To forestall any damaging misconceptions, it should be said immediately that he wasn't poisoned. Indeed it was not a matter of gastronomics but of degraded talent (or so it seemed to him at the time). Back in 1907 when the youthful Harry Raven, just out of Bay Shore High School, first applied for work in the Museum, Doctor Bumpus, then Director of the institution, told him that as far as taxidermy was concerned the Museum needed the Paderewskis of the art, not the run of the mill. Bumpus consented, however, to take him on trial. Soon thereafter, Raven's high spirits were considerably deflated when he was assigned the job of making plaster models of the Mitla ruins in Mexico, instead of work concerned more directly with natural history. This was in connection with curious ideas on interior decoration then buzzing in a number of important bonnets. Someone had suggested pre-Columbian ruins as the most appropriate motif for a Museum hostelry, and the machinery of the institution was solemnly set in motion grinding out archaeological facsimiles for the Mitla restaurant, now happily extinct.

Henry C. Raven

Since young Raven had set his heart on being a preparator of animals he found this "building trades" assignment rather distressing. He was, it is true, given several tasks, such as collecting birds on his native Long Island, which were more in line with his aspirations, but as time went on he thought to better his circumstances by following Horace Greeley's historic success formula.

However, he never reached sunny California but obtained work in the Museum at Denver where he collected specimens in the surrounding region with Albert E. Butler, whom he had known at the American Museum. The expedition continued until the fall of 1911, when he returned to New York and not long thereafter received a letter from the Smithsonian Institution in Washington asking if he would like to collect in Borneo. This was more like it. Raven accepted at once and Dr. W. L. Abbott of Philadelphia, whose work he was to take over, suggested a British tramp steamer—that is, if he were looking for "a little excitement."

Raven presently discovered that Doctor Abbott was given to understatement. The freighter's Captain signed him on as ship's surgeon. Purely, Raven supposed, as a formality. His prospects were somewhat clouded, however, before the ship had cleared Sandy Hook. The freighter was alleged to be carrying a "general cargo," but at this point he was rather dismayed to find her taking on 25 tons of dynamite.

It never went off—at least not in Raven's immediate neighborhood—but the crew provided explosives enough. Before they had lost sight of land the first mate sprang a toothache. By chance Raven had a set of dentist's hand pressure drills which a friend in the profession had given him with the idea that they might come in handy. Raven had signed up for quite a stretch in the East Indies and he inferred that he was being invited to fill his own teeth. So why not practise on the mate? The latter agreed. Raven daubed a little carbolic acid into the cavity and proceeded to attack the more or less anesthetized molar with much gusto and considerable natural skill. He cut away as much of the decayed matter as he could and filled up the cavity with gutta-percha. The mate was so pleased with the results that he refused to consult a professional dentist at any of the ports of call.

This feat established Raven in the eyes of the Chinese crew as a true healer. One night a messenger informed him that one of the stokers was "pretty sick." Raven made his way below with the Captain and found that the stoker had received a nasty bash over the head with a meat axe. It seemed he demanded hot tea from the cook at 3:00 A.M. Raven took a few stitches in the scalp and sealed it over with balsam in the old time seafaring fashion.

Later that same day Raven was standing on the bridge with the Captain when one of the boys came up and said, "Cook, him want medicine."

"Probably killed him," grumbled the Captain.

They found the cook rather badly cut up. He had watched the stoker warily, but the sly fellow hid a mechanic's hammer in the washing bucket, and the moment his erstwhile assailant's back was turned, out came the hammer and down went cookie under a series of savage blows which cut to the bone, though fortunately not through it.

A day or so later, Nature tried her own hand at trouble making and raised a terrific storm. Waves broke over the entire ship, tore away the awnings from the Captain's bridge and forced the crew to throw over considerable cargo. Various repair jobs were undertaken near Gibraltar and on the way to Algiers, but no sooner had they put out to sea again than the ship was waylaid by an Italian warship. Turkey was at that time fighting Italy, and the Italians were looking for a deck cargo of war materials. They sailed alongside, inspected the deck, then signaled the freighter on with best wishes.

In due time, Raven caught his first glimpse of the South Seas and the sight stirred his pulse. It seemed almost beyond belief that the youth who had so lately felt himself in a prosaic rut at the Museum should now be cruising through the fabulous waters of Conrad and Kipling.

South of Suez

To keep the crew occupied, the Captain ordered a rust-chipping bee, passing out hammers and swinging a scaffold over the vessel's side. This monotonous *corvée* under a blazing sun is apt to bring on what the French Legionnaires call *le cafard* (the cockroach: akin to our "bats in the belfry"). Presently one of the sailors went berserk, and while he was apparently calmly at work flaking off rust, he suddenly flung his tool down at the sea and jumped overboard. The freighter slowed and swung about as quickly as the maneuver could be negotiated. Raven, who had bought a pair of binoculars in Algiers, was told to keep the man spotted until a lifeboat could be launched. But the auxiliary craft proved so desiccated that its seams were open and it leaked like the proverbial sieve. Meanwhile the sun-struck sailor was swimming along quite as if he were born to an aqueous medium. Indeed, he was so content with the cooling brine that an oarsman had to bat him over the head before he could be corralled. There was little time to lose, and they barely made the ship before the waters closed over the lifeboat's gunwales.

As the freighter slid into Singapore the smells of coconut oil cooking and of the Chinese quarter in general were everywhere on the soft tropical breeze. Raven thrilled at this first approach to the true Orient. He was now definitely east, not to say south, of Suez and he became convinced that if the worst and the best were all one in these parts, it would be good enough for him.

Before long he went to Java where he obtained all the necessary permits to collect in Borneo, to which island he made his way by another steamer. His mission called for a broad general collection. All manner of birds, mammals and other animals, great and small, were grist for the Smithsonian's mill.

This initial trip into the interior by river boat took but two months of the six years he was ultimately to spend in the East Indies. He lived almost entirely on canned goods for six months until he got the hang of things. Then he began to "go native" for fare, as it were. He bought a 27-foot *perahu* with a huge tree root anchor and rope made out of coconut fiber, for the sails, and in this craft he voyaged for hundreds of miles along the coast of Borneo accompanied by a Chinese boy and two or three Soloks. These tribesmen were outlaws who had once made their livelihood in the Philippine slave trade until the United States armed forces took a hand in these affairs. They felt quite indignant over their extra-legal classification, and Raven had to assure them that his expedition had nothing to do with American policy in the Pacific. He adapted himself readily to their diet and general way of life, and within a few days they were all fast friends.

On shore Raven obviated the problems of overnight camping by simply putting up in native villages along the way whenever these were available. Once he stumbled on a cluster of huts at sundown and asked the affable old head-hunter chief if it would be agreeable to collect some of the animals that abounded in his territory. The chief suddenly frowned. Raven, who has a gift for languages, questioned him further in Malay, trying to find out what the trouble was. It appeared the local potentate was dead set against bringing any striped animals into the village before the rice had grown to be a foot in height. Any other kind was perfectly all right. Raven never batted an eye at this puzzling distinction, while assuring his prospective host that he hadn't the slightest intention of collecting striped animals until the rice was a foot high. The chief brightened instantly, and thereafter all was serene.

During this trip, Raven was the only white man in the whole region. In fact, much of the wilderness he explored was uninhabited even by natives; and many a time he trudged out of the virgin forest onto a perfect Robinson Crusoe ribbon of beach to watch monkeys come down out of the trees at low tide to catch crabs. On moonlight nights he would gather his native helpers, and, armed with fish nets, they picked their way along a chain of magically illumined coral reefs which had probably never before supported the tread of a human foot.

The jungle yielded all kinds of exotic vegetables and greens, and they lived off the land entirely except for rice which they kept stored in the boat together with cured meat and fish smoked over their own campfire

Hunting was hard work in these uncharted, trailless regions, but in time Raven had collected an astonishing [illegible] tacular animals as the clouded leopard, [illegible] practically unexplored it was natural [illegible] Raven's bird) named for him.

Inland

[illegible] wandering in Borneo, he bought a schooner and sailed to the Celebes to continue general collecting on that mountainous island. But here the difficulty of the terrain obliged him to use pack ponies rather than river boats. As in Borneo, he continually persisted in taking pot luck among the natives, whose cooking was very much to his taste. But here the pickings were sometimes pretty slim. For the first World War was in full swing by this time and the British had cornered most of the rice in that part of the world for their labor conscripts. The repercussions of this act were felt even in the most remote villages. Prices shot skyward and people sold all they had, saving little or nothing for themselves. As a result, Raven's Borneo-trained appetite stood him in good stead. He had learned to enjoy broiled squirrel, at which even the natives turned up their noses, saying it was only a rat with long hair on its tail. He had also devoured turtle eggs, although their whites remain in an absolutely gelatinous condition no matter how long you cook them. And what with one thing and another he was prepared never to flinch at whatever articles of diet fortune provided.

While in the Celebes, Raven took up the habit of chewing betel nut. He was supposed to pick up ethnological material in addition to his zoological collecting. This end of the expedition interested him greatly but he found it very difficult to persuade the natives to part with some of their more sacred talismans and charms. It was their custom, however, to carry suchlike in little bark cloth purses, in which they also kept betel nut and "trimmings" (lime secured from burnt sea shells and a rather villainous black tobacco). Raven's chewing was not so much part of his program for going native as it was wily subterfuge. He thereby won the right to borrow a "cud"—the men were always hospitably offering their [illegible] purses to him and he would rummage around, ostensibly selecting [illegible] accidentally-on-purpose coming up with some charm or relic which might be traded for. He got quite as accustomed to the betel nuts as to turtle eggs and although he never exactly relished the taste, he managed to make a good showing without doing any particular injury to his teeth. The natives, of course, gradually rot their own dentition, of which they take very poor care at best. Raven frequently saw them sitting on the ground filing away their teeth with a stone in order to procure a level biting edge. They regarded his own jagged incisors as unmodish "monkey's teeth" and would keep on rasping until they had ground away the enamel and some of the dentine. Raven, needless to say, drew the line at this point. However, he did accidentally take part in one rather harrowing episode which seems to supply proof positive, if any be needed, that practical jokes are seldom worth the candle.

A native girl had offered to open a durian fruit for him, and Raven, as dubious reward for this kindness, decided to play a trick on her, which involved seizing the blade of her knife in a loop of cloth and by a quick flick of the wrists snapping the blade out of her hand. As so often happens, the trick missed fire, and the blade of the knife, instead of flying off at a tangent, missed its aim and struck almost clean through the girl's thumb. Mortified, Raven dressed the wound as best he could and offered to take the girl to a doctor on the coast who, he told her, would cut the member off and sew it over nicely. This proposition did not attract her at all, so he continued to treat the patient himself and after a time found, to his relief and considerable medico-scientific excitement, that there was still circulation in the splinted digit. By careful binding he was able to restore the thumb almost to complete function—a feat of which he felt justifiably proud. He was still a good "ship's surgeon."

As a matter of fact, this surgical skill, like his interest in traps and animals, had been typical of Raven since early school days. During high school he frequently accompanied a veterinary surgeon on his rounds and had performed a number of operations under his direction. Indeed he might well have followed this profession had not his all-absorbing hobby, taxidermy, led him to seek work at the Museum.

However, his interest in animal anatomy had never slackened. Moreover, the skinning and dissecting work on his specimens only served to whet his curiosity concerning the function and evolution of musculature and internal organs throughout the animal kingdom, so that when it came time to leave the East Indies his compass already pointed in the direction of comparative anatomy.

Hollywood Africana

At the outbreak of the last World War, Raven went back to the United States, but there seemed little immediate likelihood of America's entering the conflict, so he returned to the East Indies. Then when he got news that America had finally gone in, he tried to get back again but had a very difficult time of it since many Dutch boats had been interned. Arriving by way of Hawaii, he found that he had already been drafted, though by the time he was ready to go to camp the Armistice had been signed and he was left stranded in the midst of civilization.

But Raven was not long for these parts. After a semester at Cornell as a special student in zoology, he took ship* for Africa, again serving the Smithsonian Institution as a general collector. This second expedition was sponsored jointly by the Smithsonian and Carl Laemmle's Universal Pictures Corporation, which had dispatched a lavishly accoutered staff of cameramen, actors, and a director to make "educational" films on the Dark Continent. But to get such pictures, Raven avers, they would have had to use a distinctly different type of men from the ones they took.

Both Raven and Doctor Schantz, a botanical colleague, advised them on photographing game and other natural history subjects, but the Hollywood men had a mind of their own and went off at a rather bizarre tangent which Raven felt would bring them to no good end. He was shocked, though not altogether surprised, to receive a telegram, brought several miles to camp by a native runner, stating that Armstrong, the leader, and Stoll, an actor, had been killed in a railroad accident which took place in a part of the country they might better not have entered in the first place.

After this trip, Raven returned to his original starting point, the American Museum, as a student of Doctor

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[illegible]

William K. Gregory,[*] then recently appointed Curator of the Department of Comparative Anatomy. It was not long before Raven was assisting him in various projects, among which was the plan for an Australian Hall in the Museum, favored by President Osborn. At Doctor Gregory's insistence Raven was more or less drafted for the proposed expedition, and from that time forward he became Gregory's right-hand man in the laboratory and classroom, as well as chief operator in the field.

Australia

In Australia, Raven found many strange creatures that Gregory had lectured about. He caught flying phalangers by night, and with the help of dogs, curious burrowing marsupials by day. He hunted the Tasmanian devil and trapped the echidna, a queer egg-laying mammal. The unique duck-billed platypus was also entered in his ledger, as were an amazing variety of kangaroos, ranging in size from little "hoppers," at full growth no bigger than rabbits, to giant 200-pounders. Of all the Australian animals, these kangaroos are the most significant from the evolutionary standpoint, though the whole fauna sends Darwinians into transports of joy.

By this time, Raven was prepared to settle down and write a monograph on the entire tribe of kangaroos as object lessons in evolutionary radiation. He succeeded in getting out several articles, one for the *Encyclopædia Britannica,* but after a year or two at the Museum fate contrived to toss still another expeditionary opportunity into his lap. Captain Bob Bartlett was Greenland-bound on the celebrated schooner *Morrissey* and Raven yielded to the temptation of exploring northern latitudes in general and the anatomy of narwhals in particular.

Whales, indeed, virtually flung themselves at him. He had scarcely resumed his magnum opus on the kangaroo when a young sperm whale swam into New York harbor and was killed in Brooklyn's Gowanus Canal, of all places, whence it soon found its way into the Museum. No comparative anatomist could pass up such a boon, and Raven set about dissecting it at once. The huge cadaver was placed in the new but unoccupied Hall of Ocean Life, and there the scalpel work proceeded until the late Doctor Sherwood,

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[*] See "The Evolution of an Evolutionist," by D. R. Barton, NATURAL HISTORY, April, 1941, p. 234.

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[illegible]

[illegible]

[illegible] posed Australian Hall, distractions multiplied at such a rate that he could give it little more than a lick and a promise. New York University invited [illegible] diately thereafter Columbia stole him from under its rival's nose to serve as Doctor Gregory's faculty assistant. His dissecting work, always the marvel of his colleagues and his most ab- [illegible] tract considerable attention. Within the year Johns Hopkins offered him [illegible] proper study of the apes, a project then looming large in Gregory's program.

1929 found him back in Africa, leading an expedition to collect gorillas for [illegible] Museum and Columbia. This proved an extremely difficult assignment and though Raven eventually secured several large males, he failed to bag a single female. But he did not give up without a struggle that very nearly cost him his life.

Plodding deeper and deeper into the less habitable areas of the Cameroon forest, Raven found every effort to secure female gorillas thwarted by the protective habits of these gregarious animals. Whenever he surprised a herd containing the coveted specimens, they would melt silently into the impenetrable foliage while a giant male covered their retreat with reckless charges. Month after month Raven pressed on after these apparent will-o'-the-wisps until a combination of hookworm, malaria, and sleeping sickness "made it a little difficult to do much hunting."

Raven had had malaria in the East [illegible] in Africa. And when the fever came upon him again he thought he had merely a trifle more [illegible] the usual quinine, he let it go at that, ordering his "boys" to set a camp chair for him in a likely clearing. He was too weak to stand but he knew that a half-dead white man is a better shot than these particular natives, and he *did* want those specimens.

Later it was found that what he had was the dread sleeping sickness, con- [illegible]

Not that he did much sleeping. Apparently, the chief drawback is that you *can't* sleep. The patient is subjected to a blinding headache which keeps him up all night, allows absolutely no rest, wears away all resistance and reserve fat, and finally through sheer exhaustion produces a coma (the "sleeping" part of it) which may lead to death.

[illegible] cot in a native hut with nothing but witch doctors available for 50 miles around. Then came the coma from which he woke suddenly to find a crowd of bug-eyed negroes standing over him. Said one of them, "If this white man not dead today, he be dead tomorrow." Raven was beginning to believe them. He remembered that a funeral every ten days was normal in this locality, and he thought that perhaps it was high time to send for assistance.

He also directed his camp boy to keep the kettle boiling always on the fire and the minute he seemed to be going into a stupor to make him a cup of strong tea. He hoped under this rather mild stimulation to keep alive until the messenger could walk the 50 miles to a Presbyterian Mission station where lived a certain Doctor Lehman. The latter arrived the next afternoon on a motorcycle and hustled Raven onto a conveyance, which transported him to the hospital at the Mission. There, under Lehman's skillful treatment, he partially recuperated and helped the latter in his surgical work. Raven found this experience most helpful in his study of human [illegible]

Actually it was almost a year before he was able to move about with any celerity, and even when it came time to board ship for home he had to spend most of the voyage on the bunk in his cabin, leaving the care of an astonishing traveling companion to a delighted crew.

This companion was the same individual who later startled patrons of the Museum restaurant and who is now immortalized in bronze and oils, not to mention the silver screen. Her name, "Meshie-Mungkut," was bestowed by natives shortly after Raven purchased the young chimpanzee from hunters who had killed the mother. They are Ndjem words meaning "the little swaggerer" or "the bluffer" and it referred to her habit of puffing out her chest and swinging her arms as though she were as big as a mountain. Meshie was not the first of Raven's expeditionary pets. There were black monkeys in the Celebes and another chimp on his first African expedition, whom he had taught to eat with table implements within 24 hours of her capture. But Meshie was far and away the most successful.

[illegible]

While the acrobatic young chimp was ranging spryly over the entire ship, Mrs. Raven anxiously awaited the return of her ailing husband. On the appointed day she went up to Boston to meet the boat, and it was not until then that she had any inkling of Meshie's existence. Raven, lying thin and pallid on his bunk, simply indicated his simian companion and remarked, "Uh, this is Meshie," thereby conveying his intention of adding this muscular and remarkably hirsute primate to his human family. Mrs. Raven, being the wife of so inveterate an explorer, was accustomed to such turns of fancy. Her chief concerns at the moment were his own welfare and the disheartening suspicion that his children, aged four and seven, would not recognize their father. The suspicion was well-founded. A pater familias who spends two years in the malaria-ridden tropics must be prepared to face the consequences. On the other hand, there was the delightful experience of rediscovery, not to mention the joys of establishing Meshie in the family bosom.

The latter undertaking was a huge, even a howling, success. True, during one of her rare sprees, she ripped most of the electric wiring out of the Baldwin house and bent the gas meter away from the cellar wall, but by and large she was highly tractable, quite helpful, in fact. Under close supervision she was delighted to hold the baby and feed it with a spoon, and was the constant playmate of the older children. Mr. Raven has recorded most of her household adventures in previous issues of this periodical.° Both these were written before the amazing lecture tour took place.

Doctor Sherwood, who had objected so strenuously to the Gowanus whale, adopted a far more gracious attitude toward the sweeter-scented Meshie. Indeed, he was so overjoyed by her impromptu performances in the cura-

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[illegible]

tor's dining room that he insisted on billing her for a Members' Children's lecture, with Raven as interlocutor.

The "act" went over with a resounding bang and rapidly climbed the ladder from matinée to evening bookings (adult Members' lectures), then soared to the big time circuit in suburban communities around New York.

Meshie toured with Mr. and Mrs. Raven in the family automobile, frequently cranking down the window to extend a hairy arm in the direction of a dumfounded but bravely saluting "Good Humor" man. As soon as the latter had recovered his customary bland composure, he inevitably offered a sample of his wares free of charge. Thus did Meshie outdo her lord and master by contriving to live off the land in the wilds of the U. S. A.

No trouper ever enjoyed success more than Meshie. She became enormously at home on the stage and took all the sittings for movie cameramen, portrait painters, and sculptors, in full stride. Paramount bought her film rights, and "shorts" of her activities have been exhibited on all five continents, to the delectation of the world at large. There is no telling what undreamed-of heights the "act" might have attained, had not the team split up owing to the senior partner's ungovernable wanderlust.

In 1934, Raven had to keep an appointment with Mr. Arthur Vernay to collect in Burma, and so took leave of his family. Nor could he resume the even tenor of his ways at this journey's end. For there were other expeditions in the offing: to New Zealand and Australia with Michael Lerner (1938) and with the same sportsman to South America (1941).

Then, too, there remained the vast clutter of unfinished business in his office and laboratory—the monograph on the kangaroos, the papers on the narwhal and other cetaceans, the monograph on the gross anatomy of the gorilla, the incomplete dissections of the numerous "wet" (pickled) specimens he had brought back from many far-off places.

All this and murder, too. For he has recently been enjoined as an expert witness to identify as human bone fragments, the sad remains of a slain child. Nor was this his first interruption via the law. Not long ago a kangaroo was injured, *mirabile dictu,* in a Minneapolis elevator. The creature was allegedly a "trained" performer who "boxed" professionally with its keeper. This worthy had brought suit on the

Continued on page 61

ONE-MAN EXPLORER

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 64

1. The Indian boat from which our word "canoe" is derived was 60, 16, or 6 feet long?

2. When you order a clam or oyster cocktail, always look in the shells. They may yield a pearl that will bring you a fortune.
True........ False ....

3. Is there any record of live whales appearing in the middle of New York harbor in recent years?

4. What insect that will make its appearance this June spends only the last 1/200 of its life above the ground?

5. The costliest gem is the
(a) Pearl
(b) Ruby
(c) Diamond

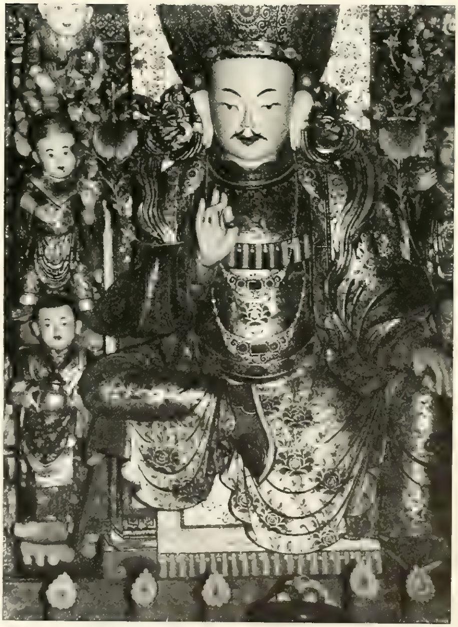
6. What sea "monster" written about nearly 2500 years ago was not generally identified as an actual creature until 70 years ago?

7. There are three gems in a gold ring whose total weight is 240 grains and two carats. One of the gems is a one-carat diamond and another a one-carat ruby. What is the third gem?

8. Burial grounds have yielded archaeologists pearls of great beauty.
True . .... False .. ....

9. Where is there a gorge comparable to the Grand Canyon within 130 miles of Manhattan?

10. The 20-foot statue of Buddha illustrated below disappeared overnight because
(a) It was made of something edible
(b) It was solid gold, and bandits made off with it
(c) An edict demanded the destruction of all figures of Buddha



WHY DID IT DISAPPEAR OVERNIGHT? A remarkable statue of Buddha about 20 feet high, photographed in Chinese Tibet by the well-known explorer and correspondent, Harrison Forman. (For explanation see Answer to Question 10, on page 64)

YOUR NEW BOOKS

A HISTORY OF 8 SCIENCES • ADVENTURE AND JEWELS
NEW HANDBOOK OF THE HEAVENS • ROMANTIC ZOOLOGY
FLIGHT OVER AFRICA • LIVING TREASURE • KUKULCAN

THE ANTARCTIC OCEAN

by Russell Owen

Whittlesey House, [illegible]

A[illegible] the adjacent oceans where antarctic [illegible] best delineated by the average limits of [illegible]

Writing with his usual clear and inter[illegible] those latitudes from the earliest philo[illegible] recorded voyages in antarctic waters, describing briefly, but adequately, the explor[illegible] scholarly and entertaining volume he shows [illegible] claims to various portions of the Antarctic [illegible]

[illegible]

FOCUS ON AFRICA

by Richard Upjohn Light

American Geographical Society, $5.00

TRAVEL [illegible] all too often on physical discomforts, or they rhapsodize on the supposedly limitless resources of the lands traversed. Doctor Light's magnificent volume, on the contrary, presents an expert survey of a vast [illegible] an aviator and an accomplished geog[illegible] photographs, all but 85 of them from the air, and mostly taken by the author's wife, [illegible] photographer and radio operator.

The Lights' air journey of ten weeks took them from the Cape to Cairo and on to Tunis. After zigzagging northward to Lake Nyasa and Zanzibar, they circled [illegible] Africa, and then followed the Nile to the [illegible] on the ground were devoted to the lions of the Serengeti. Their six-place Bellanca monoplane was equipped with every necessary instrument, and operated with rare [illegible]

Doctor Light's text is far more than a narrative of the flight. It includes most valuable discussions of the geology, history, populations, and economics of the countries along the way. Grass-burning, overgrazing, and soil erosion are serious problems in Africa, as are water supply and tsetse fly control.

The book is divided into nine chapters, mainly on geographic lines, each with its maps and photographs. To me the most exciting views are those of the summits of Kilimanjaro, Mount Kenya, and Ruwenzori. If you prefer animals there are pictures of elephants, [illegible] antelopes, and other game. Large urban centers, mines, rivers, farm lands, and native villages are all featured.

After Egypt, photography was forbidden for military reasons, and in Corsica the Lights' plane was so badly damaged by a storm that flying had to be abandoned. The closing chapter is on aviation in Africa, and then follows a copious Bibliography. For a vast panorama of eastern Africa throughout its entire length, sharply focussed with pen and camera one could ask nothing better.

JAMES P. CHAPIN.

LIVING TREASURE

by Ivan T. Sanderson

Viking, $3.50

THIS volume makes the third of what might be called the "Treasure" series, the other two being *Animal Treasure* and *Caribbean Treasure*. [illegible] written after the same pattern, and are well-phrased accounts of field studies dealing with a wide range of fauna and flora and spiced with graphic accounts of narrow escapes.

Animal Treasure, the first to appear, gained the author not only a host of readers and some very enthusiastic reviews, but also some severe criticism from experienced field naturalists who claimed that the factual structure was unequal to the strain imposed by the heavy demands of journalism. To state the case briefly, no story lost anything in the telling.

In the present book Sanderson is telling of [illegible] Jamaica, British Honduras and Yucatan. He finds many interesting creatures, he goes about his work in the field in a methodical manner, and he evaluates and develops hypotheses for the correlation of fauna and environment. He expounds an ability to predict the appearance of an animal, having seen its environment, or to describe the environment upon looking at an animal brought in by a native. This faculty can be trusted within limits and most naturalists soon observe enough to have the basis for it. It seems to this reviewer, however, that much more refinement is claimed in the Sanderson analysis than can be proved by the very examples he gives.

Sanderson and his associates work at a high tempo, they are enthusiastic, they believe in their mission. In the Introduction the author states that while they take their work seriously they do not take themselves seriously; and this probably is the reason for the rather surprising contrast between the highly journalistic accounts of personal hazards and the serious philosophic passages. The intention to reduce pomposity is commendable but the alternative has its pitfalls as well.

H. E. ANTHONY.

NEW HANDBOOK OF THE HEAVENS

by Hubert J. Bernhard, Dorothy A. Bennett and Hugh S. Rice

Whittlesey House, $2.50

THIS *New Handbook* is an entirely rewritten version of the *Handbook of the Heavens*, written by members of the Junior Astronomy Club of the American Museum of Natural History, and published a few years ago. The original book, although intended for the beginner in astronomy, was highly commended by leading professional astronomers throughout the country, and went through seven printings. The new book is twice as large and, although adapted to beginners, it is much more scientific and exact—particular attention being given to lucidity in the text. It has better star charts, in which all of the objects mentioned in the text are incorporated.

Of great interest to the amateur are the extensive observing lists of double stars, clusters, variable stars, and nebulae. These lists contain the most useful information, in the most complete detail, that this reviewer has ever seen in a book of this kind. In the case of double stars, for example, the following data are given—name of star, location, magnitude, position angle, distance apart, and colors of components; as well as remarks attracting the attention or curiosity. Pertinent data are also given for star clusters and nebulae, and for variables.

The book includes fascinating chapters on introduction to the heavens, stars around the poles, autumn and winter skies, spring and summer skies, stars of the southern skies, planets, comets, meteors and the sun and moon.

The chapter on the moon has been greatly enlarged, and is the best that we have seen. There is a new chapter on rainbows, auroras, and other wonders. There are precession directions for plotting the paths of planets and invisible objects. Also, there is an improved and highly correct Glossary, as well as Appendices on asteroids, sidereal time, etc.

All in all, the authors are to be congratulated upon an excellent, dependable, and most useful book on astronomy for the observer, and for teachers of astronomy.

Clyde Fisher.

THE LUNGFISH AND THE UNICORN: An Excursion into Romantic Zoology

- - - - - - - - - - - by Willy Ley

Modern Age, $2.75

DINOSAURS may not be extinct, but penguins are and lungfish should be. With such paradoxes Mr. Ley beguiles the reader into a pleasant sojourn in the borderlands of zoology. For anyone who does not require that romance be amatory, the subjects of this book are really more romantic than those of most novels, and the literary quality meets the standards of fiction writing.

Mr. Ley here finds zoological romance in three broad topics: mythical animals and their possible basis, animals that have become extinct in historical times, and ancient types of animals that have not become extinct. In the first category are unicorns, giants, dragons, basilisks, and sea serpents. This section ends with the remarkable hypothesis that the "sirrush" of ancient Babylon is a dinosaur possibly still surviving in Africa. The recently extinct animals are the usual interesting lot: urus, great auk (the original penguin), ground sloth, dodo, passenger pigeon, etc. Then come the so-called living fossils, in which the recent discovery of *Latimeria*, a living fish of a group thought to have been extinct for some 60,000,000 years, takes its place. Gondwanaland is used as a peg on which to hang discussions of a number of archaic (or in some cases merely rare) animals, some of which have nothing to do with the Gondwana theory.

If the book were not so good, there would be less reason to wish that it were better. Errors of fact and of judgment occur, but these are generally unimportant and it would be quibbling to emphasize them. It is a more serious fault that evidence that might be admissible in a court of law but that is entirely inadmissible in a scientist's study, is insistently accepted by Mr. Ley, who upbraids scientists who do not suffer from the same confusion. The charm and worth of the book remain, but a few grains of salt should be sprinkled over some of its pages.

G. G. Simpson.

KUKULCAN, THE BEARDED CONQUEROR

- - - - - - - - - - by T. A. Willard

Murray & Gee, Los Angeles, $5.00

THE Maya have fascinated Mr. Willard from his youth and he has taken advantage of a brilliantly successful business career to find out more about them. In this, and several other books, he has shared with others his enthusiasm. In an era when the amateur of the arts and sciences has almost disappeared, Mr. Willard's writing has a very real place. His intense personal interest is fresher than the cold objectivity of the professional scholar or the padded casuistry of the feature writer.

Kukulcan, the Bearded Conqueror is not an academic study of the latest research on the Maya. There are no records of scientific excavation nor bibliographic delving. On the other hand, Mr. Willard tells what interested him and how two early explorers, E. H. Thompson and T. Maler, inspired him with their own almost passionate enthusiasm. Mr. Willard sees the Maya as living people, not as an example of social patterns. His book is for the reader, not the student. I wish that there were more people, like Mr. Willard, who find archaeology interesting as an avocation. *Kukulcan* is a good beginning for those who think archaeology might be entertaining, if it were not for the way in which most archaeological books are so devoid of personalized human interest.

George C. Vaillant.

"**Willy LEY**

has done a real service in bringing together in one book the explorations of so many legends. He is a master of the half-world where fact and fancy meet in the realm of beasts, birds, and fishes."
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Scientific Book Club Selection

THE LUNGFISH AND THE UNICORN

An Excursion into Romantic Zoology

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MODERN AGE BOOKS, 432 4th AVE., N. Y. C.

DEVELOPMENT OF THE SCIENCES,

- - - Edited by L. L. Woodruff.

Yale University Press, $3.00

THE history of science in any of its branches is a fascinating subject. It is always interesting to trace the development of our knowledge and understanding in any field. This volume is the second series of public lectures sponsored by the Yale University Chapter of the Gamma Alpha Graduate Scientific Fraternity given during 1939-40. The presentation is not technical but designed for the layman; consequently the publication is for the general reader.

The discussions are by eight well-known members of the faculty of Yale University, and comprise the fields of mathematics, astronomy, chemistry, physics, geology, biology, psychology, and medicine. They are not written in the journalese style of the hack writers who often undertake such tasks, but each is written by a specialist in his field—by one who has the broadest dependable background, impossible in the all-round scientific writer or editor. It is obvious that one person cannot be a master in eight fields.

It is now amusing to read the prophecy of the famous French mathematician, Lagrange (1736-1813) that mathematics as a field of research was nearly exhausted and that "at the universities the chairs of mathematics will sink to the undistinguished level of those, for instance, in Arabic." In times past this feeling has no doubt been shared by workers in other fields. In the nineteenth century, what physicist dreamed that we would be forced back to a semi-corpuscular theory of the nature of radiant energy? Or, that we would see the atom split? Or, that we would see the transmutation of the elements?

In these encyclopedic chapters one finds much of human interest,—in fact they consist of thumbnail biographical sketches of the great scientists who are responsible for the development of science. Many absorbing stories are incorporated in this volume.

Clyde Fisher.

THE JEWELED TRAIL

- - - - - - - - by Louis Kornitzer

Sheridan House, $2.75

SOMEWHERE in this book the author says, "This is not a treatise on gems, but a slice of gem studded autobiography." And the reader who has seen his previous books, *The Gem Trader* and *The Pearl Trader* will know what to expect in this work. A life spent in the many phases of the gem business must supply an endless number of anecdotes to be recounted in an autobiography—more dramatic and more exciting, perhaps, than most because of the high stakes for which the game is played. But otherwise the book might as well deal with coffee, spices, or jute. In it we learn little about gems and, as before, we find the lack of that scientific background, so essential to a true appreciation of our gems. Mr. Kornitzer's attitude is probably the universal approach of a successful gem

[illegible]

[illegible] wide in its scope. Like those other works it is good adventure and romance, but here, also, the reader must be very wary in [illegible]

[illegible]

THE AUDUBON GUIDE TO ATTRACTING BIRDS

Edited by John H. Baker

Doubleday, Doran [illegible]

THE authors of this volume have had the advantage of long continued contact with the public for which they write. They know not only what it wants, but also what it ought to have, and experience has prepared them to speak with authority.

Roger T. Peterson writes the first seven of the book's twelve chapters. He writes of the methods and equipment of identification, the field glass, photography, and banding, attracting by planting, feeding, the use of nesting boxes, providing water, and creation of watered areas. Under these headings he presents a fund of useful information and advice much of which is not available elsewhere.

Richard H. Pough, in "Our Attitude Toward Predators," discusses "the balance of nature concept," a subject in which [illegible] harmonize. The same writer also gives an informing chapter called "Trespass and Your Rights." The Editor, Mr. Baker, describes various types of bird sanctuaries and the methods to be employed in their maintenance,—subjects on which he is especially qualified to speak. He also gives [illegible] covered by the National Audubon Society, of which he is the Executive Director, and [illegible]

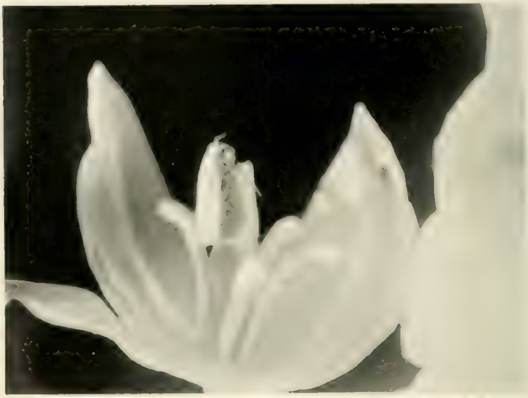
[illegible] the book concludes with a carefully compiled Bibliography. Even this outline of [illegible]

[illegible]

THE TALL TRUTH

Who Was the First Horticulturist?

By C. H. CURRAN



ONE OF THE STRANGEST TEAMS IN NATURE: the yucca and its moth

MAN prides himself upon the glories of his scientific achievements. As a horticulturist, he has accomplished much, but he is still a beginner and many of his successes have been due to accident, not intent.

In his attempt to increase the yield and beauty of plants, man has crossed carefully selected varieties, and in doing this the flowers must often be pollinated by hand. In order to prevent the flowers from being pollinated from free pollen in the air or by random insects, they must be kept covered.

Thousands upon thousands of years ago the yucca moth began doing what man has only recently learned to do—to pollinate flowers according to a fixed plan. The result is that neither the yucca nor its moth can live alone. The development of this strange relationship is truly one of the most extraordinary things in the world of nature.

To observe the yucca moth at work you must watch just as dusk is coming on or on very dark days, because it is a nocturnal insect and hides during the day in the yucca flowers, which are closed in bright light. They open in the evening, and the silky white moths come out and fly from flower to flower.

The first thing the moth does is to visit the stamens and begin gathering a mouthful of pollen. The moth's mouth has become modified to perform the job of gathering and holding the pollen. Having gathered a ball of the pollen, she flies to the pistil of the flower and presses the pellet into the forked end of the pistil, ensuring a new generation of yuccas. Then, very deliberately, she lays an egg on the pistil and off she flies.

The egg produces the young caterpillar which crawls into the developing seed pod of the yucca and there feeds upon the seeds until it is mature. When fully grown, the caterpillar makes its way to the ground and builds a tough, silken cocoon in which to spend the winter. The following year a new moth emerges just in time to repeat the process in a new crop of yucca blossoms. Everything is perfectly timed.

The yucca has become so dependent upon the moth that its flowers cannot be fertilized in any other way. And the moth cannot fertilize any other kind of flower. Nature has so arranged things, furthermore, that the caterpillars do not eat all of the seeds. We can truly say that the yucca moth was the first creature to make a plant truly dependent upon it and that, as far as we know, it was the first horticulturist.

You do not need to go to desert regions to see this remarkable team at work, for yucca plants are grown as ornamentals over most parts of the United States. It is a safe bet that if you walk up to a yucca plant and knock the top of the flower shoot sharply you will see several silvery-white moths fly out. These are the insects that control the well-being of the yucca plant, the insects that are responsible for the next generation of yuccas and which in turn are indebted to the yucca for life itself.

ONE MAN EXPLORER

Continued from page 57

claim that his pugilistic protégé could not be replaced. But Raven testified that *all* kangaroos of that species can "box." When sufficiently prodded by a human antagonist, it is natural for them to brandish their forelegs in a manner vaguely resembling the fistic maneuvers proper to the manly art of self-defense, and about all the "training" required is to tie boxing gloves on their paws.

In one sense the present state of international anarchy is a boon to Raven's reputation as a scholar. At least it keeps him within the confines of one hemisphere, and we may now hope to see an enviable procession of scientific documents flow from his pen. Behind him lies a unique career of exploration wherein he has established himself among the truly great fieldmen of our day. His future is brightened by the opportunity now at hand to assimilate and organize the well-nigh unrivaled wealth of data he has accumulated with quiet distinction in his laboratory from many far-off islands and from the depths of African forests.

MORE THAN A TRIGGER FINGER

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

Is your equipment ready for your American camera safari?

VACATION time is almost at hand. No matter where you travel you will want to bring home with you the fleeting beauty you encounter. Nothing spells distance and enchantment quite so strongly as strange wildlife,—living pictures of animals completely different from the familiar life of your own "back yard."

Taking movies of wild animals in our national parks is also one of the finest ways of seeing these conservation areas. You will have to get off the beaten track to catch the wary game—but what pictures you can get if you're lucky! Wildlife has interest, motion, grace—everything that a film should contain.

Using regular equipment

The ordinary spring-driven movie camera taking 8 or 16 mm. film is ideal for making wildlife pictures. The portability and lightness of these cameras leaves little to be desired in the way of ease in transportation.

There are two ways of using cameras that are equipped with single lenses without telephoto equipment: in the hand while stalking the game, or on a tripod with remote control on the starting button.

The hand-held camera must be grasped firmly, with the elbows pressed close to the body so that the picture will be sharp and steady upon the screen. Dropping to one knee and resting the elbow of the arm supporting the camera on the bent knee will give an even more solid support to the camera.

A tripod is usually too slow in operation to use when stalking game. By the time the legs are extended the quarry has fled. A single-footed "tripod," called a unipod, sometimes works out very well if kept attached to the camera. When detached it makes a good walking stick. Using this device, the weight of the camera is taken off your arms, so your strength can be used to prevent side sway.

When working rather close to large game it is a good idea to have another person on the lookout for arrivals from other directions. With your eye glued to the finder of the movie camera, you don't have much opportunity to see what is sneaking up behind you, which is perhaps where the best picture is to be had.

Several types of camera grips have been used to facilitate free-hand filming of moving subjects. A hand grip is available that screws into the tripod bushing on the bottom of the camera. It affords a comfortable cylindrical handhold of generous proportions. Holding your camera by this hand grip makes it incidentally an effective club if one of your camera subjects decides he doesn't like photographers, but any animal large enough to be dangerous has rights you will do well to respect.

One filmer has rebuilt a gunstock to take his movie camera so that the familiar shooting stance enables him to utilize the accuracy as well as freedom of motion of his once favorite weapon. He has even rigged up a mechanical linkage so that a pull on a normally placed trigger on the underside of the gunstock depresses the starting button of his movie camera.

If you have found where wildlife is likely to appear within a reasonable time, such as near a salt lick, you can set your camera on a tripod and arrange a remote control so that you may operate the camera from a distance. If your camera operates with a release lever, a cord can be your remote control. With the camera upon a firm tripod, a cord may be wound around the release lever, then led down to the ground and through the loop of a metal skewer which has been pushed into the ground under the tripod. The cord is then run back to where you are going to sit, wait, and hope. A pull on the cord will start the camera and probably cause the wildlife to start also. Cameras operated by pressing a button require a more complicated remote control device that should be constructed by a competent mechanic.

Long range filming

Many animals lead such an aloof existence that it is almost impossible to get close enough with ordinary movie lenses. Rocky Mountain goats prefer the high life in the summer and manage to remain sound in limb although they leap about on rocky crags that would almost worry a housefly. The only way to make satisfactory pictures of such unsociable creatures is with telephoto lenses.

Telephoto lenses come in various sizes, graded according to how much magnification they will achieve. The longest lens usually offered brings a 16 mm. camera apparently six times closer to the subject than it would seem to be. That is, any animal upon which you train this lens appears six times larger on the screen than it would appear if filmed with the regular one-inch lens.

Even more powerful lenses can be adapted to a movie camera by a machinist. When the lenses become too long, however, they require complicated supporting arrangements to prevent them from sagging and pulling the front of the camera out of line.

The trouble with too powerful a lens is that it is hard to get it to point exactly where you want. Unless some means is provided for looking right down the lens to see what it is pointing at, your aim may be pretty bad. Focusing becomes difficult, atmospheric haze interferes, and the image loses its sharpness with excessively long lenses.

The six-inch objective is, therefore, the most powerful telephoto lens normally supplied for small motion-picture cameras. It combines reasonable power and sharpness with not too great physical size. A lens of this type is also excellent for aquatically minded animals when you don't happen to have a boat handy. Movies of birds and small mammals are also much easier with such a telephoto lens. Your close approach with movie camera is then unnecessary, with the result that shy creatures feel less afraid and get used to the intruder more easily. A tripod is strongly recommended for all telephoto work.

Try some real animal films this summer. They make grand film fare for young and old, and the joy of making them is unsurpassed.

ALONG the Rhode Island shore, osprey nests were not difficult to find but were generally inaccessible. This tree was scalable, but the nest contained merely one egg and the parent bird flew menacingly about the intruder

A SINGLE YOUNG OSPREY, not quite old enough to fly but well able to show his anger, occupied this nest. His portrait is shown in the other photographs

LETTERS

Sir:

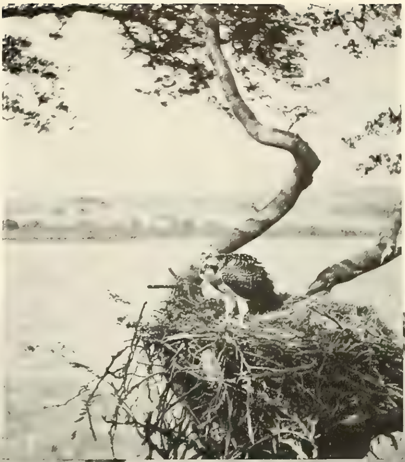
[illegible]

If you have stood on the shore with the sea breeze flinging salt into your face and craned your neck to watch a bird that was neither gull nor eagle climb and wheel into the blue or flap straight as an arrow over the trees and inland to its nest, clutching a dripping fish in its talons and uttering a peculiar scream,—that bird was probably an osprey. The accompanying photographs were taken without any telephoto lens in Rhode Island.

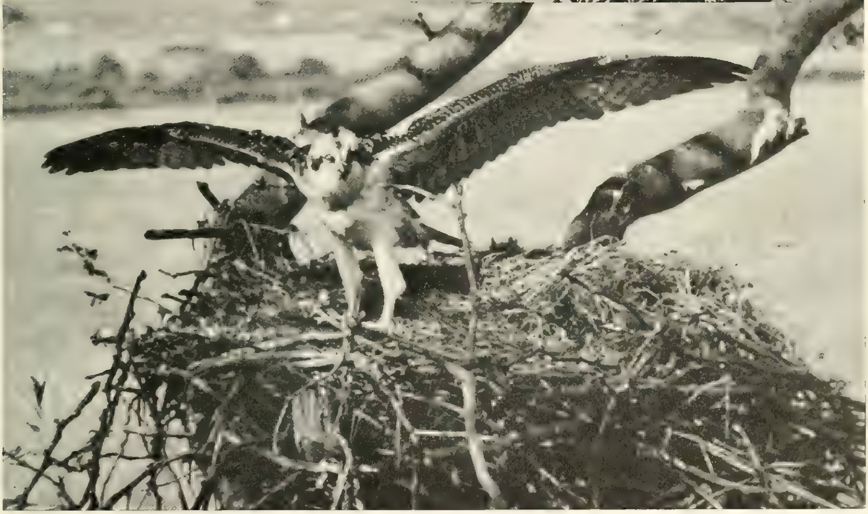
[illegible] may easily understand my desire to follow one of these majestic birds to its home. Being a photography fan, my purpose was not to rob the nest but to secure some good pictures. Consequently, after splashing around for a whole afternoon in a salt-water marsh with an ornithologist friend, who was looking for bitterns and some kind of tern, I demanded that before the summer was up he should lead me to a colony of osprey nests.

Our first trip was essentially exploratory and took us to the eastern shore of the Sakonnet River from Tiverton to Little Compton. We used an ancient Model-T and ventured down all the side roads, which were none too good, to find the water. The nests were rather easy to spot, and often the birds themselves would unwittingly direct our gaze. As we bounced along the road a large female suddenly fluttered out of a near-by tree. She circled and returned now and then to the nest. Her behavior was so strange that we stopped the truck, and I resolved to climb the tree.

The tree proved difficult, and I was rather glad to have a sheath knife, because the owner of the nest was persistently diving and making a noisy row. Fear kept her



He shifted uneasily from leg to leg and hissed with rage



Spreading his beautiful wings to their full three-foot span, he seemed ready to leap at the intruder and sink his talons into an arm. The parents did not oppose the visitors but appeared rather to be deliberately trying to entice the young bird to fly

at a distance, however. Imagine my surprise to find only one egg. The smell of rotten fish was terrific. I slid back to the ground disappointed.

Another time I spotted a whole family of fledglings raucously playing in complete security at the top of an old water tower. When we approached, the young immediately became quiet. The parent birds glided to separate roosts at opposite ends of the field and communicated in shrill screams. Sometimes the male would fly above our heads and behave fiercely. But a rotten wooden ladder terminated in space about 30 feet up, and once more my hopes were dashed.

It was not until our second expedition "into the field" that we met with rare success. At the edge of a pasture we discovered a fine nest in a climbable tree, something very infrequent. We could see what appeared to be an adult bird over the edge, but he never took flight. We were amazed to find that it was a handsome young osprey, restlessly moving about in his ample quarters. He was about 40 or 45 day old and apparently had not yet learned to fly. He shifted uneasily from leg to leg and hissed with rage at the intruders. His yellow eyes gleamed defiance. From time to time he spread his beautiful wings, which were over three feet from tip to tip, and seemed to threaten to leap at one of us and sink his talons into an eye. We left him unharmed. We noticed with surprise that another osprey flew from tree to tree at the far end of the field, but made little fuss. We had expected active resistance. I surmised that the parent birds were deliberately trying to entice the young one to fly, though I may be mistaken. At all events my curiosity was satisfied, even if I did not get a photographic record of the osprey's development from the egg to the flying bird.

R. Z. Zimmermann, Jr.

Philadelphia, Pa.

Continued on page 64

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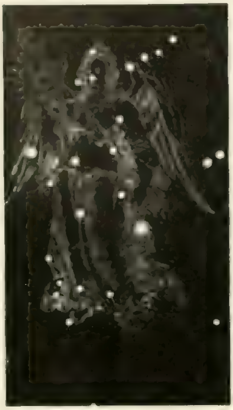

The Hayden Planetarium will present the following during the summer months:

June . . . COLOR IN THE SKY

"Color In The Sky" during June will display the many colorful aspects of astronomy—rainbows, aurora, stars, spectra and, of course, the sky itself, with dawn and sunset effects portrayed. Experiments, too, to show not only "what" but "why."

●

July . . . OUR SUN

"Our Sun" is studied during July, and on clear afternoons will be brought into the room and projected on the dome. Maybe there will be sunspots visible. At night a picture will substitute. And color will play a part in learning its make-up.

●

August . . . SUMMER STARS OVER NEW YORK

"Summer Stars Over New York" will give us a picture of an August night. The old imaginative pictures of the ancients, the more realistic, but [illegible] pictures of the [illegible] made with powerful telescopes.

●

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LETTERS

HUMAN, WOLVES, AND GILA MONSTERS

[illegible] letters have been received recently at NATURAL HISTORY [illegible] contradictory [illegible] [illegible] [illegible]. The questions posed by these two readers are [illegible] [illegible] Dr. T. E. [illegible] of the Department of Mammalogy of the American Museum [illegible] them.

[illegible] cannot be given, if indeed there are any absolutes [illegible]. However [illegible] [illegible] [illegible] [illegible] [illegible]. It is not the custom of pumas to [illegible] [illegible] [illegible] [illegible] and then charge in for the kill. Possibly in the early days of settlement pumas may have attacked men, but [illegible] only a very few cases are known, and in each instance the animal was incapable of securing its normal prey. Without a reliable eye-witness, we must reject this story as being quite unlike all observations by trustworthy persons.

2. *[illegible] kill the young if he finds them?* There are two contradictory opinions on this question and insufficient information to decide completely and finally. Also individual pumas [illegible] differently, just as individual [illegible].

[illegible] [illegible] with female [illegible] [illegible] [illegible] [illegible] [illegible] information [illegible] [illegible] [illegible] food [illegible].

3. *Do [illegible] attack man?* Before rifles were common it is quite possible that wolves occasionally attacked man. [illegible] there is no reason why they should not have done so. American wolves [illegible] different from European wolves, and in the Middle Ages there were man-killing wolves in many places in Europe. Today a [illegible] an injured man or one without a gun might be attacked, and if wolves were in a pack and desperately hungry they might attack even an armed man. However, few wolves are now left anywhere and these have learned to be secretive and cautious where man is concerned, for wolves are highly intelligent.

4. *Are Gila monsters deadly poisonous?* Human beings are not all equally injured by poison, some individuals are much more resistant than others. There are several cases recorded where persons have died from the bite of this poisonous lizard. The venom is as poisonous as that of most rattlesnakes, but the means of getting the poison into the blood and tissues is much less efficient in the Gila monster. A single bite, rather than the chewing and worrying required to get enough venom into the tissues, would probably be more painful than dangerous.

• • •

SIRS:

. . . I like your magazine very much and wish to take the opportunity to tell you how much I like it. It is one of the first class magazines of the country.

CLARKSON POTTER

Mendham, N. J.

• • •

HONOR

DR. GEORGE GAYLORD SIMPSON, eminent in the field of paleontology, has received the distinction of election to the National Academy of Sciences, whose membership embraces a selection of the most celebrated names in science. Readers will recall numerous articles by Doctor Simpson in NATURAL HISTORY, which give evidence of the breadth of his interests as well as his outstanding gift for exposition. He is a member of the American Museum's Department of Paleontology, in whose interests he has made numerous expeditions, particularly in South America, and his scientific writings have contributed important new knowledge on the history of mammals and other subjects. His popular book on Patagonia, *Attending Marvels*, has had an enthusiastic reception by the general public.

Answers to Questions on page 57

[illegible]

[illegible] creature no doubt owes its origin to [illegible]

[illegible] instead of carats. See page 22

[illegible]

Buddha disappeared because it was of [illegible] the Fifteenth Day of the First Moon. [illegible]

September NATURAL HISTORY 1941

Pigeons in Modern Warfare · Gems · Before the Aztecs

Treasure Island of Animals · Margaret Mead · Colbert

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The American Museum of Natural History, 79th Street at Central Park West, New York, N. Y.

LETTERS

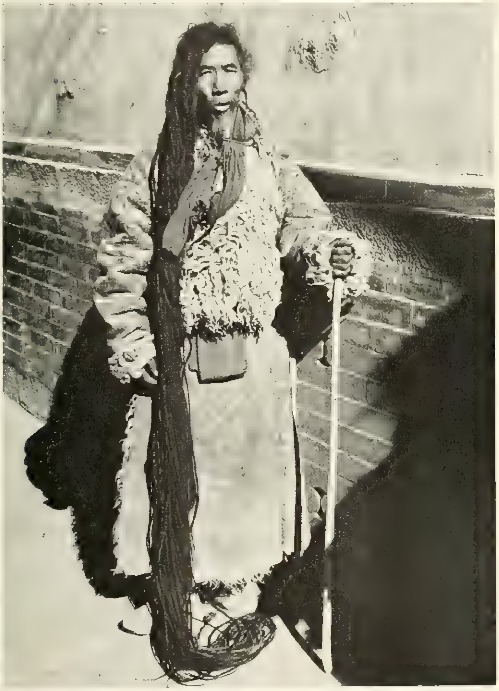
From a magazine editor:

". . . Your new number, just out, is a dandy. Each one seems to be better than the last. . . ."

* * *

From a scholarly shut-in in Denver, Colorado:

". . . The entire contents of the magazine is attractive and interesting; and the book reviews at the end are done in a way which lends value to the criticisms which one finds there. In most magazines one finds criticisms covered by one individual, and unless he has a distinctly open mind his views are liable to be rather biased in many cases. This work in NATURAL HISTORY is assigned to specialists in the various fields of literature, which makes these reviews particularly valuable."



HAIR. Sometimes a dozen feet in length, locks like these identify their owner as a Nukwa, or priest of Bonism, pre-Buddhist religion still found in Tibet. The priest's "crowning glory" is usually coiled atop his head like a snake, symbol of immortality. The unusual photograph was submitted by the explorer and correspondent Harrison Forman

SIRS:

On 28th April last you wrote me a very nice letter in reference to my inability to send money over to you for my next year's subscription . . . mentioning that you would refer it to the Membership Secretary . . . To my astonishment and deep gratitude I received a letter yesterday [July 10th] stating that my membership has been paid for until November, 1943.

I am commencing to write and thank the different people concerned in this wonderful gift to me. I think the generosity and most unexpected way you Americans have of dealing with matters is most overwhelming, and I appreciate it from the bottom of my heart.

One of your readers also very kindly wrote me and asked me if he could send on his copies when he had read them. Of course, I do not deserve this further honour, and I am acquainting him with the

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[illegible] plates, and we are all grateful to you.

[illegible]

[illegible]

[illegible]

* * *

Sirs:

[illegible] articles are [illegible] so skillfully planned and arranged.

[illegible]

Washington, D. C.

* * *

Sirs:

. . . I appreciate your beautiful and [illegible]. I have been filing the copies ever since I subscribed. I very carefully read the articles which interest me and copy extracts from them. Then I make a bibliography of all the articles so I can find the material I want whenever I need it.

It seems to me that you have the most beautifully illustrated magazine of any nature publication. Your covers are certainly exquisite. I often wonder how you can publish such a beautiful magazine at the price for which it sells. . . .

[illegible]

Arlington Heights, Ill.

* * *

Sirs:

I had hoped to contact you personally while at the Museum last Wednesday—but the sheer grandeur of the North American Wing drove all else from my mind until far too late in the afternoon. It would be difficult to say which was the greater thrill—the finished groups in their breathtaking beauty and perfection of detail, or the glimpse backstage where the miracles are wrought.

Among other things, I wanted to say to you how greatly I have appreciated and profited by the articles on photography by Mr. Charles H. Coles. Thanks to his remarks on the use of the Wratten 2-A filter with daylight Kodachrome for sky-lighted and cloudy day shots, I have achieved artistic results. . . . I hope that he is to be a regular contributor.

As for the magazine, each month I put down the current issue with the feeling that now *this* number can never be surpassed and each succeeding month does just that!

I have been visiting the Museum at intervals ever since I was a child, when it was easily housed in one building. How gloriously it has fulfilled and exceeded the promise of those days! It is always new—never static. It never fails to give [illegible] week it had a special message as I walked through those great [illegible]. It came home to me suddenly that here in the beloved city where I can [illegible] the very few groups of scientists left in the world whose talents are still being used in the accumulation and spread of knowledge for the common good instead of senseless, hateful destruction. It gave me a swift new vision of what America means, of the manner of men she heeds, and of the appreciation and opportunity she offers to those who had their beginnings elsewhere. The newspaper headlines, full of wars, strikes, organized minorities and political chicanery, might all be of another world entirely.

My guest turned to me suddenly and said, "Can you imagine a plane dropping bombs on this place?" I can, and the thought makes me wish desperately that I were again young enough to wear a uniform.

[illegible]

Hartford, Conn.

* * *

Sirs:

Some time ago there appeared in one of the popular digest magazines, in an article entitled, "Fish Cannot Read or Write," these words: "Fish are color-blind—scientifically proved." Now, if that isn't a case of Ripley!

Will you kindly advise if such is the case and if so, how proved scientifically? Any information will be greatly appreciated by a number of interested persons.

Harry Curry

Binghamton, N. Y.

This "fishy" question is answered by Dr. Frank A. Beach of the Museum's Department of Experimental Biology, as follows:

Mr. Harry Curry is quite justified in questioning the accuracy of the statement, "fishes are color-blind." This unwarranted generalization is probably based upon the results of a series of experiments conducted 30 years ago by a German investigator named Hess. As a result of several investigations Hess did conclude that a number of species of fishes are color-blind. However, a great number of more recent experiments indicate that this conclusion was incorrect.

Several studies prove that minnows are able to distinguish 20 different colors. The minnow can be trained to accept food that is held in red tweezers and to refuse the same food held in green tweezers. Mud minnows can learn to leap from the water to seize food offered under a blue light and to avoid bait presented under a red light. Gray snappers possess the same ability. Even the trout, to which Mr. Hough specifically refers in the article, has been shown to possess color vision. Other

[illegible]

NATURAL HISTORY Magazine's full color covers are available on the same heavy paper that is used on the Magazine at a cost of 5¢ each, plus a charge of 5¢ for postage on any order up to ten copies.—ED.

MUSEUMS IN THE EMERGENCY

During the last few years Museums have been criticized as old-fashioned, out-of-date, lacking in verve and splash and modernity. The critics have called many of the exhibition methods stuffy and conventional and have lamented the slow and careful pace to which Museum staffs have held in the modernization of exhibits. The high-pressure salesmanship of modern advertising has been recommended to us. We have been urged to think more of influencing the masses of our visitors and less of fidelity to our materials.

And in the midst of this, we find ourselves as a country in an emergency, when it is necessary to think about problems of morale and national enthusiasm. Those who seek to find among the American people the enthusiasm for national ends which is so essential, find that again and again they are faced with cynicism and apathy, in people who feel they have been over-propagandized, over-sold. The tricks of the propagandist have been labeled and displayed, the machinations of the advertiser are known to everyone, the public is dishearteningly canny, suspicious of every means of communication open to those who would fire the imagination of the people with the importance of the present hour. Dishearteningly suspicious they are—except of Museums. The Museums, almost alone among the various means of communication that have been exploited to push and prod people about, to make them feel, or want, or buy, have remained uncontaminated. Because the staffs of Museums have insisted on saying: "Is this true?" instead of asking: "Will this make a hit?"—they have kept the people's trust.

Those who enter the doors of our Museums do so in a faith that they will not be tricked or deceived, that no one will seek by high-powered lighting arrangements to make the facts of science other than they are. They go out from the doors of the Museum believing in one of the foundations of democracy—that it is possible for an individual, by slow, honest, exact study to find out more about man and the world in which he lives. For an hour or so they have been able to trust their eyes and let their minds rove over materials which have not been arranged to impress, to convert, to push them around, but merely to tell them as much of the truth as is now known, and that quietly.

So at this moment, when America needs the strong deep enthusiasm of every citizen for the democratic way of life, the Museum which has refused to give up its faith in the materials of science, the Museum which has scorned to substitute emotional appeals for orderly demonstration, finds itself with a definite place in the national program. As a place that the people trust, it is now a place in which they can renew their trust in science and in democracy.

Assistant Curator of Ethnology,
The American Museum of Natural History

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President   Roy Chapman Andrews, Sc.D., Director

VOLUME XLVIII—No. 2 ★ ★ ★ ★ ★ ★ ★ **SEPTEMBER, 1941**

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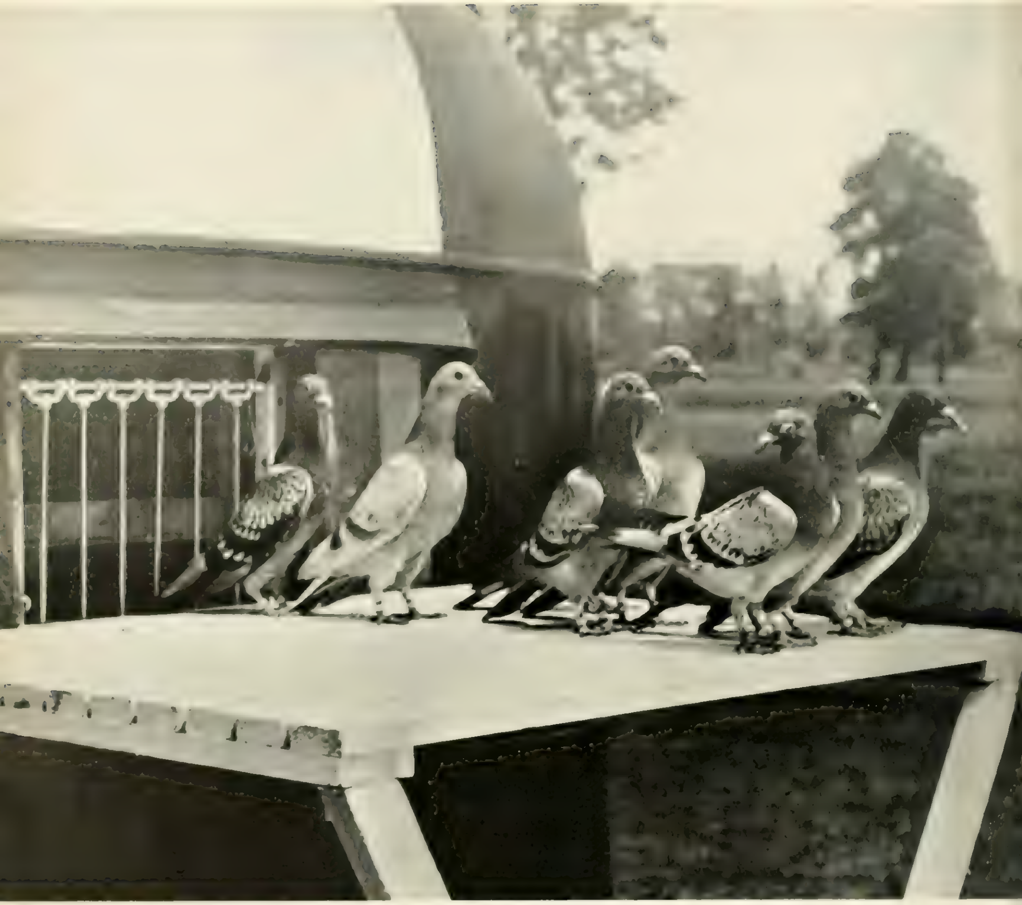


Smoke, darkness, and the din of battle fail to daunt the world's most remarkable messengers, who perform new aerial wonders in the service of the nation—all for a little affection and a handful of corn

IN the rush of war preparations, Uncle Sam's feathered battalion has not been forgotten. Despite the advances in mechanical communication, the Signal Corps of the United States Army is adding thousands of new pigeons to the skeleton force now in service. Normally numbering only a few peacetime men, the group of army pigeon handlers called pigeoneers has been greatly increased, with the men hard at work drilling the large batch of recruits that have been streaming into the government lofts during the last few months.

The importance of the homing pigeon has been recognized since Brutus, besieged by Antony, hit on the idea of dispatching a pigeon to Octavius for reinforcements. The Dutch brought the birds to central Europe for the wars in the Netherlands, and William the Silent used thousands of them at the siege of Haarlam in 1573. Later, during the siege of Paris by the Germans in 1870, the work of the pigeon was so effective against the invaders that falcons and hawks had to be trained to break up the system of communication.

It is significant that at the start of the present war the English War Department ordered every loft in the country visited and the pigeons forced to fly. Native birds went back to their own lofts, while Ger-

(Left) HOMERS AT HOME on the open-air "porch" of an Army trailer unit: pigeons whose messages may be expected to reach their destination when no other methods of communication are possible

FEATHERED BATTALION again takes wing

By RORY O'SHANE

man homers had to wing their way back across the Channel. The heavy damages inflicted in the last war by foreign agents and sympathizers working with German birds evidently had not been forgotten.

Home patrols, likewise, now maintain a vigilant lookout for solitary parachute jumpers. The Nazis have a neat little trick of flying agents across the Channel at night and dropping them off by parachute. Along with the agent comes a wicker basket housing two or more pairs of homing pigeons. These are lodged in previously selected lofts and released with messages for the German Intelligence when the occasion arises.

Not to be outdone, the British have adopted an old stunt which was originated toward the end of World War I. Small gas balloons are fitted with metal rings that open automatically at a predetermined time. Pigeons are placed into baskets equipped with small parachutes. When wind and weather permit, the baskets are snapped onto the metal rings and the balloons sent sailing into enemy occupied territory. After the elapse of a certain amount of time, the metal rings part, allowing pigeons and baskets to shoot gently to earth. Within each basket is a message asking friendly French, Dutch, Czech or other allies for definite information valuable to the English. The finders are instructed to slip the message into a container on the pigeon's foot and release the bird. The next morning English bombers may be unusually fortunate in locating amunition factories, airdromes and troop concentrations.

Pigeons also are doing yeoman service with the British Navy. Mine sweepers and trawlers, not equipped with wireless, carry them along for emergencies. When danger looms in the North Sea or English Channel, the birds are sent winging from 50 to 100 miles to shore for help.

The Signal Corps of the United States Army occasionally used pigeons to carry messages prior to the World War, and in 1886 an American Signal officer predicted their extensive use and recommended that official provision be made for their maintenance in the Army. It was not until 1917, however, that actual provision was made for a section to be created in the Signal Corps to operate a pigeon messenger service. The major powers engaged in World War I prior to the entrance of America were successfully using thousands of pigeon messengers on all fronts. The homer's ability to spring into the sky, spiral the field once, and shoot instantly off at terrific speeds over artillery barrages and clouds of poison gas, made the winged messenger priceless when wires were down and human runners unable to sneak past enemy sharpshooters.

Recognizing this, American war chiefs scrambled to press into service men who could mobilize and handle pigeons. From the ranks of America's 16,000 bird fanciers developed the finest group of army pigeoneers in the world, with the result that by the end of the war many thousands of American pigeons were in active service in France, and every Army camp in the United States had a government loft. Besides the 110 lofts in the States, there were many on the Mexican border, in the Panama Canal Zone, and in the Hawaiian Islands.

Records show that the Signal Corps birds were more successful in delivering messages than either the telephone service or human runner. Despite obstacles ranging from enemy snipers and trained hawks to poison gas and bad weather, the Signal Corps completed delivery of over 90 per cent of the pigeon messages entrusted to it.

Fort Monmouth, New Jersey, under command of Major General J. O. Mauborgne, is the nerve center of the Signal Corps' system of scientific breeding and

Three Lions photos

(Right) A THIN TOUGH TISSUE in an aluminum capsule bears the message just received by this soldier via pigeon special delivery. Long documents are set in large type and photographed down, then enlarged at the destination

[illegible] mod-ern warfare.

The development of the bird's homing instinct to [illegible] goal. Contrary to popular belief, all pigeons are not imbued by nature with the requisite degree of homing instinct and intelligence. The renegades and numskulls among them must be weeded out to preserve the purity of the strain.

Army trainers are not greatly concerned with an explanation of the homing instinct. Taking it for granted, they are concentrating on systems of selective breeding and training that will intensify the trait.

The training routine requires patience and persistence. Teaching the birds how to "trap" is the first essential. A pigeon able to fly 500 miles is useless for communication if it refuses to enter the loft with the message when it gets home. Too much valuable time would be lost coaxing the bird to come close enough to be caught.

When the "squeakers" are able to fly—about four weeks after birth—the initial lesson in trapping begins. The pigeons are kept in the loft for 24 hours without food, then taken a few yards outside the loft and released one by one. At the same time a pigeoneer inside the loft loudly rattles a tin cup full of grain, causing the hungry birds to swoop instantly for the loft. This process is repeated until the association of food and loft is indelibly fixed in the minds of the pigeons. To encourage the association, pigeons are always fed immediately upon entering the loft after a flight.

The lofts are kept in sight for the first practice flights, with the distances increased to a matter of miles as landmarks begin to register with the pigeon. When mating season arrives the training grind is increased in tempo since pigeon men know that a pigeon's speed and accuracy are heightened when there is a family waiting for it in the home loft.

Group flights with recording of each bird's speed is the next step. Wicker baskets holding 15 to 30 birds are hauled great distances from the Fort, and the birds liberated as a unit. Automatic clocks punch out the split second of release and arrival, superior pigeons being easily identified since each bird is banded with a seamless aluminum leg band bearing a registered number.

Over a period of years these methods of breeding and training have resulted in striking improvements of speed and stamina. At one time a sustaining flight of 200 miles a day was considered excellent, and a mile-a-minute clip the absolute tops. Today, however, [illegible] is not considered worth his salt, while fast Army birds have breasted the breezes at over 70 miles an hour.

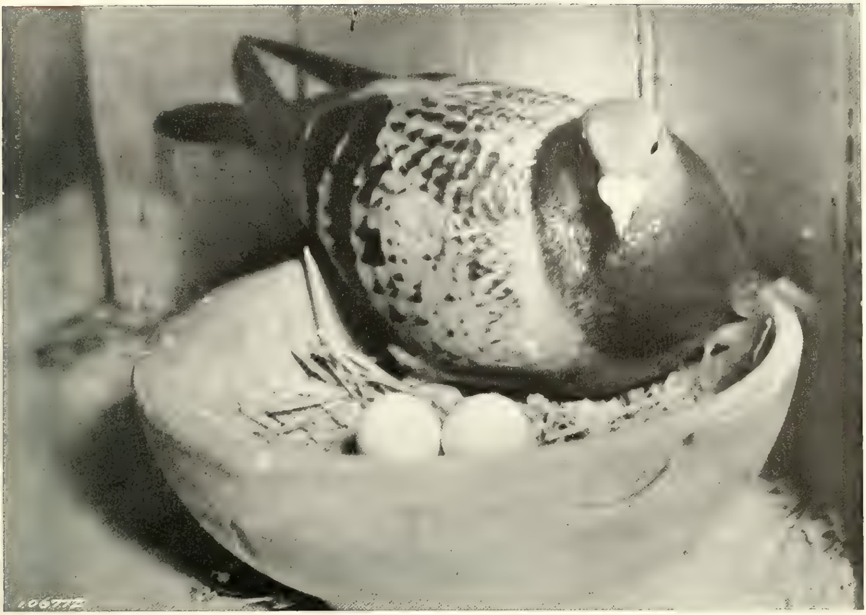
Another feat has been in the field of night flying. A pigeon will fly from sunrise to dusk, then will pick it up next morning and wait for the break of dawn. Averse to the idea of having vital messages delayed while the bird caught his forty winks, the Signal Corps, following the World War, conducted experiments to ascertain if homing pigeons could be trained to fly at night. The experiments were successful and as a result, the Army now has a body of trained flyers who can be relied upon to carry messages either by day or in the darkest of nights.

A large number of new mobile lofts have recently been procured by the Signal Corps which are equipped with distinctive combinations of colored lights to aid the night flyers. Although it is not an easy matter to resettle a bird in a mobile loft, kindness and patience will do the trick. The younger the bird, the easier it is to remove old associations and inculcate new ones.

The pigeon is hobbled and released on the roof of the mobile loft, hungry, of course, where he can respond quickly to the rattle of grain in a tin cup. After several days of this exercise, the birds are unhobbled and released at gradually widening distances with constant retrapping until the new loft becomes the target of their homing instinct.

The Army uses several different means of transmitting messages. The older style of fastening messages to the bird's tail feathers has been supplanted by slipping messages written on thin tough tissue into a small aluminum capsule sealed to the bird's leg. The Signal Corps is also able to send larger documents and photographs by fastening the package so skillfully about the bird's breast that wing movements are unhampered and wind resistance not increased. The most recent technique consists of setting the message up in large type, then photographing it down. The film is inserted into the capsule and then dispatched. At the receiving end the film is removed and the message re-magnified into a readable state.

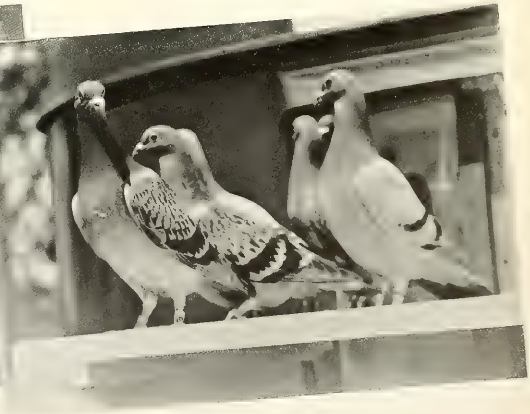
Signal Corps pigeons may also be used as aerial photographers for the Army. German and Japanese War Colleges are reputed to have been using Neubronner's panoramic camera to obtain aerial pictures by pigeons. The Signal Corps is aware of the possible application of the pigeon to aerial photography, but as yet no formal adoption of this method of combat reconnaissance has been made. One of the devices for taking aerial photographs by pigeon consists of a tiny two-inch aluminum camera which is attached to the pigeon's breast with an elastic band. As the pigeon soars over the countryside, two inset cameras,



(Above) Lady Mable, a Signal Corps thoroughbred who raises her boys to be soldiers. Through years of painstaking research, the United States Army is developing a breed of birds that will surpass any yet known to modern warfare

Photos by U. S. Army Signal Corps

Future orderlies. In five weeks these nondescript "shavetails" will have the full plume and sheen of thoroughbreds and be learning how to carry messages for generals of the United States Army



Future mile-a-minute men: five-weeks-old messengers to be, who for the first time come out of their streamlined loft to gaze into the realm which they may have to share with war planes and high artillery fire

UNSUNG HEROES of World War I, operating from one of the old-fashioned pigeon trailers, or *arabas*, which followed the French Signal Corps to the front lines. The same wagon, accommodating about 100 birds, was used at first by the U. S. Army

one moving forward and the other backward, snap [illegible] exposures at regular intervals.

The mechanism of this camera consists of a tiny rubber ball operating through a tube connected to the shutter. The rush of air, passing through the ball releases the lever, thus clicking the shutter, and the camera brings back to General Headquarters an excellent [illegible] enemy terrain, position of troops, and location of batteries.

Nothing yet conceived by man approaches the intelligence of the pigeon's flying [illegible]. The bird will skirt fogs and shift from water to land routes with an uncanny instinct for better flying conditions. In mountainous regions he swoops into valleys where there is less wind resistance. When bucking strong headwinds, the bird tacks as cleverly as the master of a racing sloop, or it will climb miles to avoid strong air currents. On reaching home, if storm prevents him from landing, he will hover above for hours until he spots an opening, then he will drop like a stone for thousands of feet to reach the lighting board of the loft.

A dream of military commanders since the days of Alexander the Great has finally come true through recent experiments conducted by the Signal Corps

PIGEON message center: a modern unit in a streamlined army, capable of travel at 60 miles an hour. Signal Corps birds have proved more successful in carrying messages than either the telephone service or human runners. Under the highly intensified program, the birds are learning new tricks and will assume wider duties in the Pigeon Section at Fort Monmouth, New Jersey. The Signal Corps now has military pigeons that will actually carry messages two ways. These new Signal Corps homers can be dispatched from Division, Army, or Corps headquarters with messages addressed to front-line units, which they will deliver at mile-a-minute speed. Remaining at the front-line positions for approximately ten minutes, these pigeons will then return with answers to their communications, delivering them safely to the starting point. Officers and soldiers of the Signal Corps are close-lipped about divulging information about this, but it is known that a flock of these especially trained pigeons has successfully responded to their training at Fort Monmouth.

Thus today, the pigeon, one of the oldest implements of war, has kept pace with every development of the military. With greater efficiency than ever, it is still carrying on where the streamlined mechanizations of man might fail.

Nor does it ask much in the way of compensation. As a French general has commented, "No wires to string, no big plants, no necessity for lives lost as linesmen work under fire—and no expense. All he asks is a little affection and a few handfuls of corn."

Photo by U. S. Army Signal Corps

(Above) WAR GAMES, somewhere in the United States: blue-bloods being trained to carry messages through smoke and din of battle

TRAILER APARTMENT: interior of one of the mobile field units, where, on returning from more serious strife, each pigeon knows his own "pigeon hole" and will fight vigorously to defend it

Free Lance Photographers Guild

Three Lions photo

(Right) LOFTS at the pigeon "nerve center" at Fort Monmouth, N. J. The lofts are connecting, and each has nesting quarters, roosts, screened porch, and a landing platform painted a distinguishing color

Champion of Champions

By JOHN K. SHAWVAN

Major, U. S. Signal Corps

In him centers the accomplished dreams of military commanders since the days of Hannibal and Alexander the Great. He is the fastest two-way military homing pigeon, the champion of champions among the Signal Corps' homing pigeons in the United States Army. In fact, one could go further and say he is the champion of all the homing pigeon messengers of all times in the history of the world.

So we introduce to you Mister Corrigan. He is a true blue-blood, and army officers know all about his ancestry for 525 pigeon years of life. The histories of 167 famous champion racing pigeons appear in his pedigree, and among them are the names of many great winners and famous army messengers. His great-great-grandfather, "Always Faithful," was recorded in the "Hall of Fame" as a national champion many pigeon years ago.

Since the history of the world began, military victories and defeats have frequently hinged upon messengers. The military message from Marathon to Athens gave us the Olympic games, and a message from Napoleon to Grouchy had it been delivered might have avoided two world wars. One from Custer to Benteen might have saved 700 lives and blotted a catastrophe out of our history books. Mister Corrigan could have carried them all with the grace and ease of his beautiful wings and would have brought back the answer at mile-a-minute speed.

On last March 25, an officer of the Signal Corps of the United States Army believed that he could teach and train a thoroughbred homing pigeon to leave its loft and carry a military message to a point many miles distant, deliver it, and immediately return to its loft with the answer.

Mister Corrigan, then a five-weeks-old squeaker, was selected with 22 of his feathered schoolmates to attempt this mission. Sixty-one days later, rising in the air on his now full-grown and powerful wings from his concealed pigeon loft on the military reservation at Fort Monmouth, New Jersey, he winged his way to a group of four officers tensely awaiting his arrival at a crossroads on the outskirts of Freehold, an airline distance of twelve miles from his pigeon loft. Entering a small container on the ground between the officers, Mister Corrigan delivered his message, and five minutes later he was again in the air with the answer on the return trip to Fort Monmouth. The feat had been accomplished, and from that day on no military unit of the United States Army could be severed from communication with higher command by enemy activities. Mister Corrigan had become the champion of champions, the first and fastest two-way military homing pigeon in the world.

The exact technique of the training of Mister Corrigan remains one of the most closely guarded American army secrets.

WATER FLEA CIRCUS—Through the magic eye of the microscope, you can observe the antics of scores of different tiny actors, the clowns and "aquabats" of the water fleas. An amazing pageant in which one mother can produce thousands of daughters but not a single son—until cold weather threatens her "act"

By Myron Gordon

Fellow, John Simon Guggenheim Memorial Foundation

IN early spring, soon after the last traces of ice have disappeared from fresh-water ponds, the life story of daphnia begins again. The water flea embryos stir in the black egg cases, which, invisible in the mud and decaying leaves, have wintered in the bottom ooze.

A few degrees above freezing are enough to liberate the embryos from their tough horny egg capsules. At first all the young that are born are daughter daphnia; not a single son is hatched. Eight days after birth a young female water flea has reached ripe womanhood. On the ninth day of her life, in spite of complete sexual abstinence (there is not a single male in the colony), her tiny eggs within the brood chamber hatch into diminutive embryos. On the virgin mother's tenth day of life, she gives birth to about a dozen female water fleas. As soon as the young are released they start life on their own and soon produce a line of daughters of their own. On her thirteenth day the founder mother daphnia produces another dozen young, three days later another dozen, and so on.

When Louis E. Wolf, of the Experimental Fish Hatchery of the New York State Department of Conservation at Rome, N. Y., was a student at Cornell University, he kept an hour by hour and day by day lifetime record of the remarkable reproductive powers of these creatures. He raised individual water fleas from embryos to adults in half-pint milk bottles containing a suitable culture medium. Several times a day he fished a daphnid out with a wide-mouthed medicine dropper, placed it in a drop of water on a glass slide under a microscope, and recorded the progress of its development. In this way he discovered that ***Daphnia magna,*** a ***big*** daphnia one-quarter of an inch long, produces about 100 young in about ten broods in a lifetime of about 40 days. One matriarch gave birth to 40 broods in a lifetime of 130 days. If, in a period of 90 days, all the descendants of this female were to live and each in its turn were to produce others in normal quantities, over twelve billion water fleas would be born, enough to form a single-strand belt of daphnia around the earth.

Many species of water fleas far exceed the reproductive powers of ***Daphnia magna.*** For instance, at the same temperature (77° F.), ***Moina,*** a tiny humpty-dumpty shaped daphnid one-sixteenth of an inch long, reaches adulthood in half the time; and at 95° F. it develops from birth to motherhood in just 38 hours.

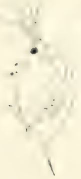
No wonder a pond that appears sterile one day may be swarming with tiny aquatic animals the next. Daphnia are creatures of opportunity. Those that live in temporary bodies of water never know when their aquatic world will end. Thus, as if to forestall extermination of their species, they make the most of their time by multiplying. Yet mere multiplication, especially of females only, would be of no avail in the face of drought or severe frost, for their bodies cannot resist these forces. Nor could their shriveled or frozen bodies be revived when better conditions returned.

Daphnia survive drought and frost by means of their weatherproofed eggs. These eggs cannot be produced by females alone, but require for their creation the usual mating of male and female. Where do the males come from? Virgin females produce them when either frost or drought threatens.

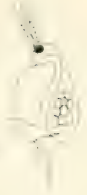
When the temperature falls, respiration is reduced, the growth rate slowed. Similarly, when drought is impending, the water of the evaporating pool becomes charged with organic wastes, oxygen is decreased, carbon dioxide increased. Perhaps these radical chemical changes have a direct effect upon the developing eggs of virgin female daphnia. Whatever the actual forces may be (scientists are still working on this problem), drought and frost are anticipated by the water fleas in the production of sons as well as daughters.

The males are puny creatures, much smaller than the females, each with an amazingly enormous eye with which better to search out a mate and with long, specially developed claspers with which better to embrace her.

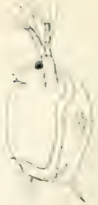
After mating, the mother daphnia's eggs no longer develop into ten or more embryos. The nourishment contained in a dozen eggs is pooled into one or two, which become much larger than the unfertilized eggs produced in former broods. The fertilized eggs become covered with a dark horny substance produced by a special gland. Thus protected, the eggs resist drought and frost. At this point, even should the mother daphnia die and her body decompose, the horn-covered eggs survive and hatch when favorable conditions return.



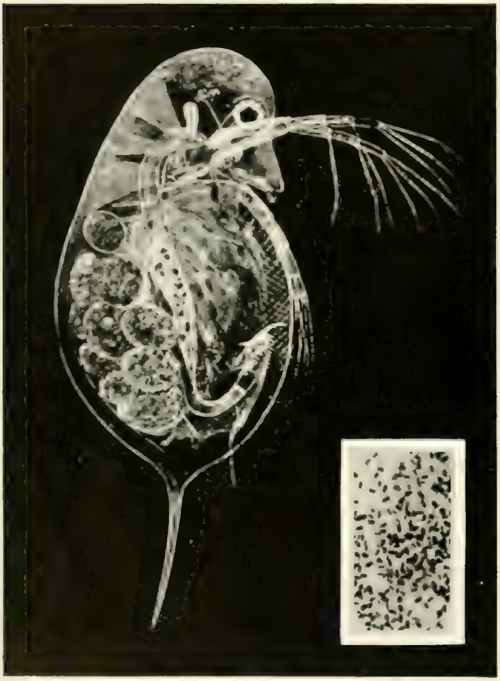
Commonest of all daphnia, *Daphnia pulex*



Daphnia longispina, actually the size of a pinhead



The giant daphnid, *Daphnia magna*, ¼ inch long

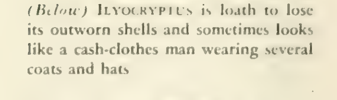


[illegible]

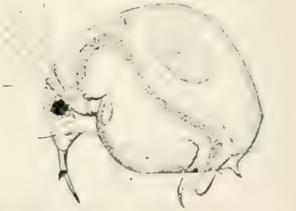
[illegible]

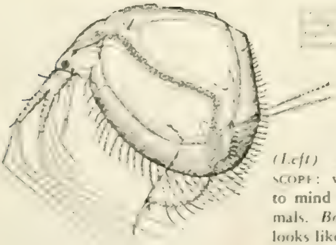
(Left) IN 90 DAYS one female water flea and her descendants can theoretically produce several billion offspring. But most of them are eaten by fishes and thus help keep a balanced life on earth. The large oval bodies are eggs. Life-sized individuals are seen in the insert

(Below) THE LONG SPINES on the antennae of *Drepanothrix dentata* are used in locomotion like ski poles

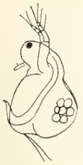


(Below) ILYOCRYPTUS is loath to lose its outworn shells and sometimes looks like a cash-clothes man wearing several coats and hats

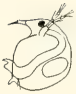




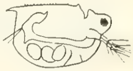
(Left) UNDER A MICROSCOPE: water fleas suggest to mind various larger animals. *Bosmina longirostris* looks like a toy elephant



Highly prolific *Moina macrocopa*

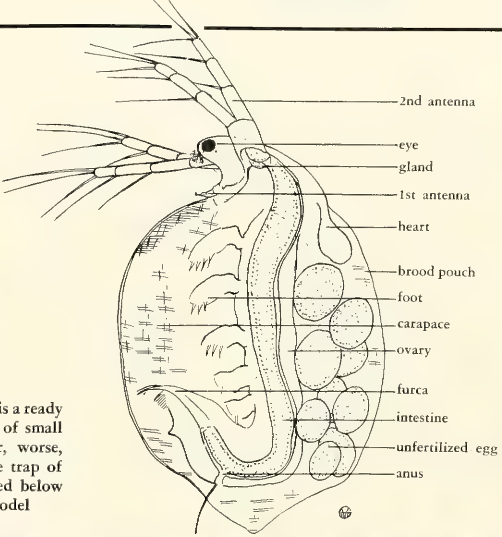


Scapholeberis mucronata swims on its back



Elephant-faced *Bosmina longirostris*

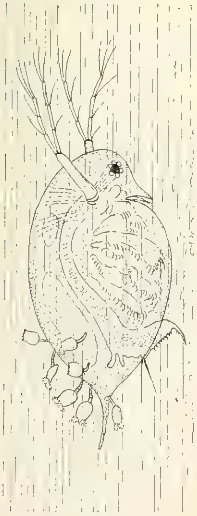
Drawings by Myron Gordon, from The Fish Culturist


2nd antenna
eye
gland
1st antenna
heart
brood pouch
foot
carapace
ovary
furca
intestine
unfertilized egg
anus

MAIN ANATOMICAL FEATURES of the monkey-faced water flea, *Simocephalus*

(Below) THE PERSECUTED WATER FLEA is a ready victim of tiny hitch-hikers in the form of small clinging rotifers as shown below. Or, worse, it may be ensnared by the bladder-like trap of the water plant, *Utricularia,* represented below *(right),* highly enlarged, by a glass model

Courtesy of Frank J. Myers



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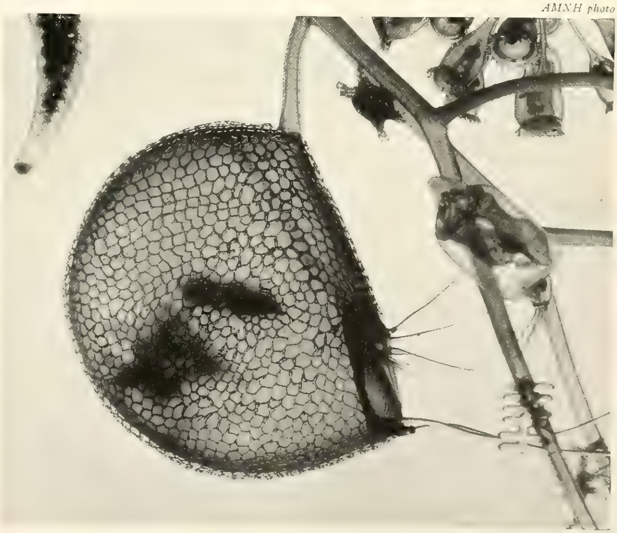


[illegible] and spines on the seeds of plants. They become fastened to the feet and bodies of wading birds and mammals that wander into the pool. Thus the hitchhiking weatherproofed egg cases are strewn over a large area. Many drop off in inhospitable, arid places, but a few may be brought to another pond far away. Even should a single ephippium be successfully transported to a new aquatic home, it might suffice to start a new colony because of daphnia's parthenogenetic (virgin birth) method of reproduction. This accounts for the world-wide distribution of some [illegible] for instance.

Back in [illegible], when the microscope was still a newly invented gadget, a Dutch physician by the name of Swammerdam amused himself by examining life in the waters about his home. Swammerdam was one of the first to see a daphnia and all its elaborate internal organs. He thought that daphnia were related to the fleas, or insects. Superficially water fleas do look and move like real fleas, for they have a hard-shelled, compact little body and they move through the water in a series of hops.

In those days it was the custom to name an animal new to science in a phrase that appropriately described it, so Swammerdam called the creature under his lens *Pulex aquaticus arborescens.* This may be translated freely as "water flea with branching arms." But as their characteristics and habits became better known, Swammerdam's *Daphnia pulex* and other water fleas were placed closer to the shrimps and the crabs.

Like shrimps and crabs, water fleas molt periodically, shedding their tough, horny, and sometimes slightly calcified outer covering. The horny covering extends to the branching antennae, and these appendages have given water fleas the group name of Cladocera, those with "branched horns." Like shrimps and crabs, cladocerans pass, momentarily at least, through the soft-shelled state, at which time they are particularly weak and helpless. Furthermore, just as moths and butterflies pass through the larval stages as caterpillars, and frogs as tadpoles, the shrimps, crabs, and water fleas pass through their larval stages as nauplii. These immature creatures are the common denominators of the crustacean group. The nauplius of cladocerans, with but two known exceptions, never leads a free life, but is tucked safely away within its mother's brood pouch. When a daphnia is ready to be born it is a miniature edition of its parent. America's foremost expert on Cladocera, who is also President Emeritus of the University of Wisconsin, Dr. Edward A. Birge, says that there are hundreds of species of water fleas in the United States and probably thousands in the world.

Most daphnia are extremely small, 1/100th of an inch in length, but they make up in numbers what they lack in size. As a group they represent one of the most important links in the chain of living food organisms from microscopic plants to man. Cladocerans convert the almost invisible yet inexhaustible supply of bacteria, diatoms, and algae into a form and size more edible to larger carnivorous aquatic animals. The tiniest larval fishes feed on tinier water fleas, larger fishes eat the smaller, and so on until they become the food of our food fishes.

The vast assemblage of microscopic water plants in seas, lakes, and ponds are compared by Dr. James G. Needham, Limnologist of Cornell University, to the quick-growing ever-present edible weeds, berries, grasses and other forms of low herbage found on land. In water and on land, plants are the mainstays of animal populations. Doctor Needham compares the millions of microscopic cladocerans to the hordes of small plant-eating rodents that infest the fields. The larger herbivorous water fleas, like daphnia and their associates, he compares to the vast herds of hoofed animals of the plains.

On one occasion in Mendota Lake in Wisconsin, Doctor Birge reported that, "The surface waters were crowded by the daphnia, and great numbers of perch were feeding on them . . . along the shore as far as the eye could reach." Taking a sample of the water in the densest part of the swarm, he found 1,170,000 *Daphnia pulicaria* per cubic meter. "Even larger fishes do not disdain these animals," he says. "The great spoonbill *(Polyodon)* fills its stomach with *Bosminae,*" but only those large fishes equipped with straining devices can utilize these small creatures directly.

Under a magnifying glass, most water fleas are funny enough to be put in a circus. Walt Disney probably never meant to make Dopey of the Seven Dwarfs look like one of the daphnia, but Dopey certainly bears a resemblance to some of them, and so do his brothers.

The body of a water flea is covered by a cloak that extends without much of a break over its head. Its coat looks like the oversized parka that Dopey wears, except the daphnia's outfit is a bit better fitting and it has no loose tails trailing behind.

The facial expressions of many water fleas resemble those of toy elephants, monkeys, porkers, pug dogs, parrots, and the Seven Dwarfs. Sticking out in the region of what would be our shoulders and extending over their heads is a pair of antennae that looks like a pair of arms. These add to the resemblance these creatures bear to the animals pictured in nursery books.

The antennae of insects, shrimps, and crabs serve as feelers, but water fleas use their antennae as arms, and it is with strokes of these wing-like appendages that they are able to swim about. Just as you may recognize your friends from afar by the mannerisms of their gait, many water flea experts can often recognize some cladoceran species by the way they move about. *Daphnia pulex,* for instance, has long antennae, and their slow beat makes this creature progress through the water in a series of hops; it bounces up and down and moves forward like a mechanical horse on an amusement park race track. The antennae of *Bosmina,* the water flea that looks like a toy elephant, are short, and, because they are waved rapidly and continuously, the little animal moves through the water smoothly. The heavy-bodied *Simocephalus* (literally "monkey-faced") has a rotating unsteady motion that is produced by rapid strokes of its long antennae.

"The spiny haired one," *Drapanothrix,* has stiff spines attached to its antennae, and it pulls itself forward over plants like a skier with the aid of his ski poles. Another curious water flea, *Ilyocryptus,* lives hidden in muddy places. Its antennae are short and point downward; with them it drags itself over the bottom. The scientist who discovered *Ilyocryptus* found that it is not only a "hider in the mud" (for that is what its name means) but is a slovenly creature to boot. For instance, it is loath to cast off its outworn shells; these pile up on its back in several layers like hats and coats on a cash-clothes man. Furthermore, as these mud dwellers creep through the mire, they become covered with vegetable growths and filth. No wonder the scientist Lieven called one of them not only *Ilyocryptus* but *sordidus,* too.

Daphnia has two pairs of antennae, but only the second pair is used in swimming. The antennules (the first pair) are hardly developed at all in the females; they remain as mere sensory stumps near the mouth. In the male *Daphnia,* antennules become well developed; they become long, powerful, and turned like grappling irons. They serve to grasp and embrace the females.

The water fleas are nonconformist in the use of their appendages. Feet that serve the crabs for the customary function of getting around and which are used by shrimps as oars in swimming are used by water fleas for breathing and food gathering. Their five or six pairs of thin, leaf-like feet are equipped with long, fine hairs. They wave continuously to and fro, producing a current which flows through the half-opened shell, bringing with it fresh water for respiration and food. Breathing valves are located at the base of the feet. The mouth receives particles of food in the form of tiny plants and decomposing matter. The long fine hairs of the feet are kept scrupulously clean by constant grooming with a comb of stiff bristles located on the lower part of the abdomen. Behind the mouth, near the entrance to the alimentary canal, water fleas have a gland that aids in the digestion of their food. Owing to the transparency of their bodies a particle of food may be traced as it passes down a short intestine and emerges as waste matter through the anus. The artist who drew the pictures for the book *Through the Alimentary Canal with Gun and Camera* might have watched a daphnia at dinner. All these processes can be observed with a low power microscope. Or, if you happen to be in the American Museum, the antics of a living daphnia can generally be seen projected on a screen from the microvivarium.

The rhythmic beating of the tiny heart of a daphnia is always a fascinating sight to an amateur microscopist. Somewhat like a simple water pump, the heart sucks blood through a series of valves that come directly from the body spaces. When the heart constricts, the valves close and the blood is forced forward in a stream. Although there are no blood vessels, the flow of blood always follows the same course. As it passes, nourishing the organs, a corpuscle may break ranks to grapple with an enemy fungus spore and put it out of action.

After the beating heart, the constantly "roving" eye of a daphnid is likely to attract the attention of anyone peering at a water flea under the lens. As an embryo, each daphnia has two eyes, but as it grows older the two lateral eyes fuse along the mid-line. Like the compound eyes of insects and crustaceans, the eye of a water flea is made up of many tiny segments—like cells in a block of comb honey. All these creatures have mosaic vision. On the outer fringe of their intensely black eye, water fleas have a number of small crystalline lenses which reflect the light in a peculiar twinkling way. The cyclopean eye is moved by three pairs of muscles which give it a squinting effect. All in all the comical daphnid appears as cockeyed as a one-sided Ben Turpin.

A stout nerve connects the eye to the brain, which, although tiny, is good enough to cause the animal to scoot frantically for cover when a small fish lunges at it and misses. Many fine, long, hair-like spines over the body give the water flea the feel of its environment. Sensitive spines near the mouth allow a cladoceran to discriminate between edible and inedible particles brought to its mouth by its feet. A water flea may take diatoms only when diatoms and blue-

[illegible] It may [illegible] fully [illegible]

Cladocera are found in all sorts of waters, the [illegible] Shallow, weedy backwaters of lakes with fairly constant water levels attract most kinds. Here they find warmth, shelter in the weeds, abundant food, and se[illegible] *Daphnia* and *Moina* are found in turbid, temporary pools, especially near farms, where food is plentiful at least while the water lasts. Only a few species live in or near the bottom mud of lakes. Cladocera that inhabit open water of large lakes are usually carried over from year to year parthenogenetically, that is, by virgin birth; the males are rarely seen. In some species the males have never been discovered.

There is hardly a more defenseless creature in the world than a water flea. It is the Number One food organism of the aquatic world. Not only the higher but the lower animals feed upon it. So lowly an animal as the *Hydra*, which is hardly more than a simple tube of cells, takes a water flea by stretching out a sting-bearing tentacle, stunning and then forcing the wriggling prey down its blind-alley gullet. Even the single-celled *Stentor*, a funnel-shaped protozoan representing the most primitive of all animal groups, preys upon daphnia. This is deep disgrace, because cladocerans are among the extremely few multi-cellular animals that are eaten whole by single-celled ones. But the greatest indignity to which a water flea may be subjected is to be snared by the bladder-like traps of *Utricularia*, a lowly water plant.

Leptodora, the tiger, is a renegade member of the otherwise meek fraternity of Cladocera; it is a ferocious killer. Like a pike with jaws snapping rushing in suddenly among a school of minnows, *Leptodora*, appears out of nowhere to ravish the dense, swarming masses of water fleas. In keeping with its stealthy, raiding tactics, its body is phantom-like, transparent, and hardly visible except for its enormous black eye. After a successful raid, the tiger-daphnid's body takes on the color of the devoured victims, for these may be seen packed tightly in its cellophane-like alimentary canal. In keeping with its power as a beast of prey, *Leptodora* is a giant among the puny water fleas, for it is three-quarters of an inch long. For speed to seek out and overtake the darting, hopping, jumping, elusive water fleas, the rapacious raider is equipped with a powerful pair of great antennae. With slow flapping of these wing-like antennae it may cruise easily through the water seeking its quarry and then, by an increase in the tempo of the beats, speeds to make the kill.

It is fitting that this black sheep of the mild water flea clan be placed in a cladoceran family of its own. Unlike most cladocerans, its young, immediately upon hatching, fend for themselves as nauplii. As *Leptodora's* whelps grow older these wolves among the lamb-cladocerans refuse to burden themselves with the confining cloaks that are characteristic of other daphnia. *Leptodora* means "insignificant coat"; its long, slender, streamlined body, freed of encumbrances, is as trim as a sleek pursuit plane.

The ease with which water fleas are kept, bred, and their internal machinery observed, has made these transparent, diminutive creatures as useful as guinea pigs in biological laboratories. Experimental evolutionists, led by A. H. Banta of Brown University, have worked with water fleas for over 20 years at the Carnegie Institution of Washington's station at Cold Spring Harbor, Long Island. They have just issued a short statement of their results which covers several hundred pages. Every year dozens of learned papers are published recording the scientific results of investigations with Cladocera. As might be expected, many of these deal with the economic importance of water fleas to man. Methods of improving the culture of these valuable creatures on fish farms as food for young bass and other fish are constantly being suggested. Some papers deal with phases of daphnia biology that seem to be of purely theoretical interest. For instance one scientist studied the influence of supersonic waves on them. Another treated them with X-rays; still another tried to find out whether water fleas were attracted to, or repelled by, particular bands of the spectrum, visible and invisible to the human eye.

The famous Russian physiologist, Metchnikoff, observed some of the earliest demonstrations of phagocytosis in *Daphnia*. He watched their reactions to the invading spores of the fungus *Monospora*. When swallowed, these sharp-spined fungus spores pierce the water flea's intestine and escape into its body cavity. Here the spores come in contact with the flow of the creature's blood. The spores are stopped in their tracks by fighter blood corpuscles which, amœboid-like, engulf the enemy and put it out of action.

Today, water fleas are going to play a part in the medical division of our defense program. Many invaluable drugs must be checked on living organisms before being used, in order to establish the exact potency and toxicity of each newly manufactured lot. Daphnia, with all their sensitive organs visible to the pharmacist, have been found to react quickly when microscopic but calculated doses are administered to them.

A FLOWERLIKE ANIMAL EATS A FISH

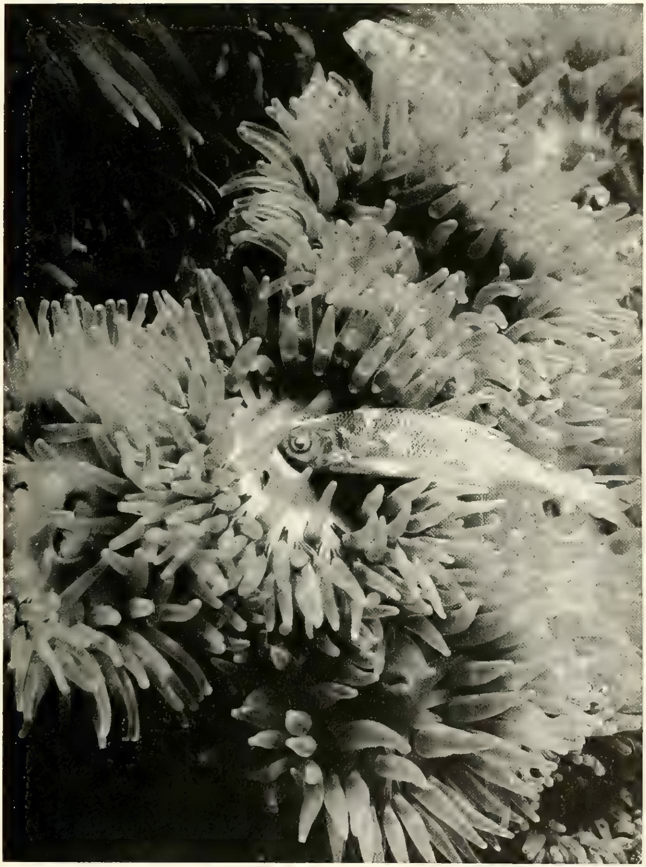
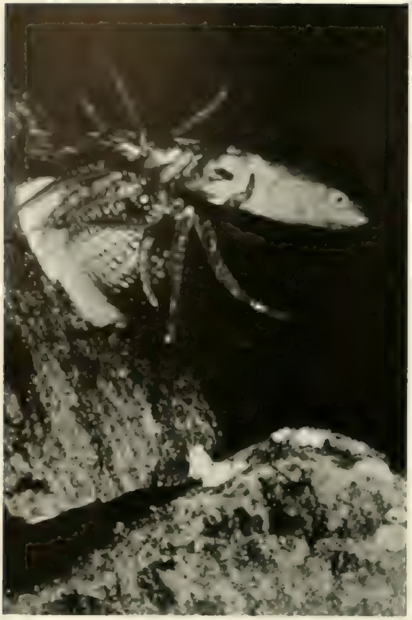


Photo by Dever from Black Star

The photographic story of a remarkable event that may be seen on the floor of any shallow sea, in which a sedentary animal robs its prey of motion and then consumes it

In dangerous territory. Though the translucent tentacles of this group of sea anemones are almost flowerlike in their beauty, they are a living trap for the fish that ventures among them. No trouble appears to be brewing here, but turn the page to see the anemone's voracious habits

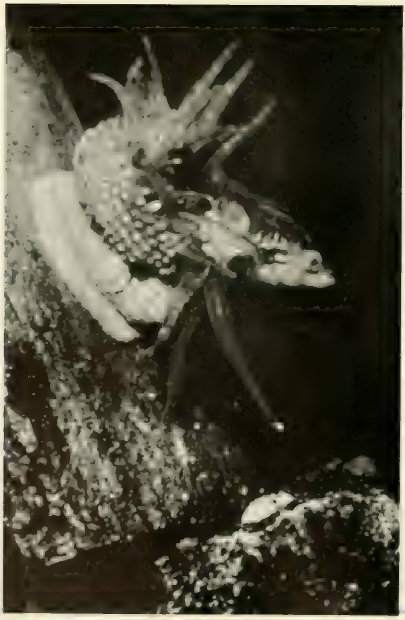


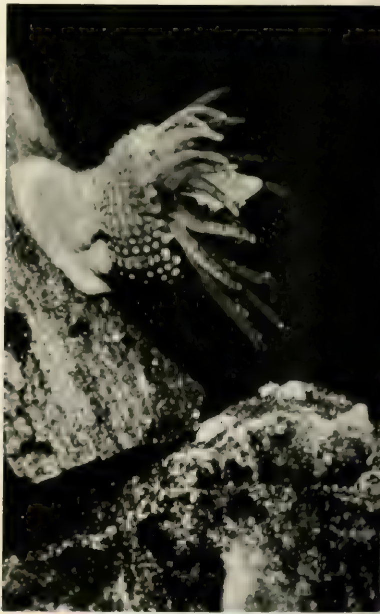
WHEN the fish comes in contact with the tentacles, it is seized and stupefied by action of a poison. Thousands of sting cells arm each tentacle, and each sting cell is equipped with a long hollow thread. On contact with prey, the thread is squeezed inside-out like the finger of a rubber glove, to bring into action the barbed tip

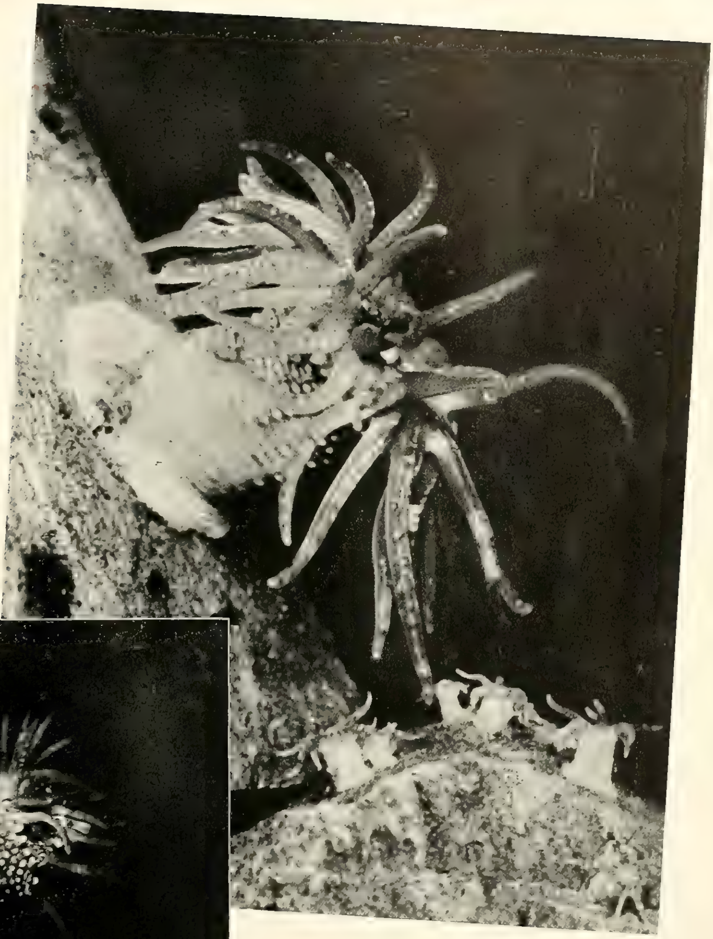
(Left, below) ENFOLDING THE FISH in its long feelers, the anemone draws its prey, powerless in the multiple grip, into the body cavity

(Middle, below) AS IT DRAWS the fish in, the anemone extends itself, reaching its body forward and surrounding its captive

(Right, below) ALMOST LOST TO SIGHT. The anemone has pulled itself like a stocking around the fish







(*Above*) THE SEA ANEMONE pours digestive fluids into its body cavity and absorbs the imprisoned fish as nourishment. It is now ready for its next meal. On the rocks below are young anemones, which have developed from larvae thrown off from the adult above

GEM FOR AUGUST

You may choose sardonyx, the gem Good Queen Bess used as a token of friendship, or the yellow-green peridot

By FREDERICK H. POU

Delicately carved sardonyx cameo

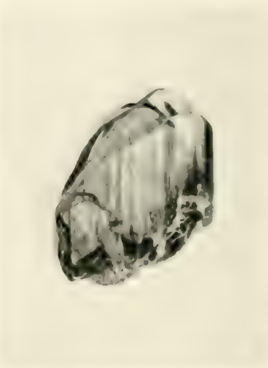
THE most famous of all sardonyx gems is the one in the ring which Queen Elizabeth gave the Earl of Essex as a token of her friendship. When under sentence of death he returned it to her as a sign of his peril; it fell into the hands of a foe, and Essex was executed. The stone has great historic value, which few gems can match, certainly no other sardonyx.

Sardonyx is one of the varieties of quartz, that protean mineral of which we have already spoken. Amethyst is a crystallized variety; bloodstone is a microscopically crystalline variety; and sardonyx is likewise cryptocrystalline, which means that distinct particles are scarcely recognizable even under the microscope. The name is derived from a brown color, the "sard," and "onyx," which means (finger) nail and refers to a resemblance in the luster of this translucent material to that of a nail. The ancients probably made no distinction between carnelian, a reddish variety of quartz, and sardonyx. Today we mean, by this name, a variety which consists of colored bands, one white, one brown. Like many of the quartz gems it is relatively common and inexpensive.

Cameos are frequently cut in this material. The white layer is partially removed to leave a white figure standing out upon a brown background. This work must be done with the greatest of care. Good cameos are made only by true artists, for the material is hard to work and does not permit any mistakes. Before the days of electrically driven tools, cutting was an even more laborious art. Today people are likely to undervalue the effort, patience, and skill that have gone into the cutting of such a gem. Nowadays, pressed [illegible] for less [illegible]

To the people of the Middle Ages the sardonyx was one of the most potent of [illegible] The [illegible] idols. Eyestones were often believed to have a beneficial effect in the treatment of [illegible] eloquence in the wearer and to symbolize [illegible] harmonious combination of the two contrasting bands in a single stone.

An alternative stone has been proposed for August,—the yellow-green peridot, which rarely receives proper appreciation. Peridot is the gem name of the mineral chrysolite, a member of the rock-making mineral family of olivine. Chrysolite oli[illegible] that forms in many rocks; the dark color distinguishes the rocks as *basic*, as opposed to the light-colored *acidic* granitic rocks. Olivine is usually so embedded in the rocks that the crystals are shattered and cracked. It readily becomes transformed into another, softer mineral. The gem localities are very few; in reality only one or possibly two important localities for this gem exist. The first is one of the oldest known gem localities, a place which was known to the Egyptians. This completely barren desert island in the Red Sea is known as St. John's Island. It is composed of volcanic rocks in which are found chrysolite crystals, sometimes over an inch in length. Crystals seem to be reasonably abundant at the locality, but the operation of the [illegible] they are worked [illegible] Workers [illegible] on the island must have all of their supplies carried to them,—even their drinking water comes from the mainland.


A peridot crystal from St. John's Island in the Red Sea, the most important source for this gem and one known to the ancient Egyptians

Small peridots have been found with garnets on the anthills in the West, and many of the green sands of Hawaii are composed of small fragments of this gem. However, stones of any size are rare, and the beauty of the peridot can only be realized in the larger specimens. Recently, fine green stones from Burma have appeared on the market, but few details of this occurrence are available.

Peridot is an old gem and is frequently mentioned in the Bible under the synonym chrysolite. But there is great uncertainty about the nature of Biblical chrysolite, and many authorities believe that it is what we now call topaz. The ancients may well have had peridots; and a description of an island in the Red Sea where the stones were found is very significant. According to Siculus, the stones glowed in the dark but were invisible in the day. Their location was said to be marked at night by an inverted vase, so that workers could return by day to dig the stones from the rock in which they were embedded.

Marquise cut peridot—98 carats

Peridot was thought to be very effective as a charm, if set in gold. Then it kept away the evil spirits of the night but only if strung on a hair from a donkey's tail and worn on the left arm. It would seem that peridot was rather weak; other stones required less stage setting. The suggestion is made that the effectiveness was derived from a resemblance to the light of the sun and that the power was that of the sun's rays, dispelling darkness and evil spirits.

GEM FOR SEPTEMBER

Curator, Gems and Minerals,
American Museum of Natural History

Sacred among gems is the regal sapphire, whose frequent six-rayed star defies man's best attempts at synthesis

THE SAPPHIRE of the ancients is not the same stone as that which goes by this name today. In all probability their sapphire was lapis lazuli. Moses is supposed to have been given the Ten Commandments engraved on slabs of sapphire, but since pieces of such size are utterly impossible, only lapis could fit the description in this passage. Azurite, too, probably went under the name sapphire before the more precious lapis lazuli was discovered. In each case the name has been applied to the most precious known blue stone.

The sapphire we recognize today is a blue variety of the mineral corundum, whose red variety is known as ruby. There are other shades of gem corundum and they are known as "fancy sapphires." But the jewelers' stone for September is the blue sapphire, fourth member of the regal group: diamond, emerald, ruby, and sapphire. Just as the ruby owes its color to the chromium impurity in the normally colorless aluminum oxide, the sapphire owes its shade to iron and titanium. We know a great deal about the coloring of the corundum gems because we have been able to approximate them synthetically. However, the violet of amethyst, the gray of smoky quartz, or the green of fluorite are still unsolved mysteries.

Much as we know about the synthesis of the corundum gems, we have not quite been able to get nature's coloring into the stone, and the trained eye can recognize the genuine stone by color alone. Anyone can learn to distinguish the other differences, —few synthetics pose any problem.

One popular variety of corundum has no synthetic rival. That is the star sapphire, a stone which has been popular in this country for many years but which has only recently been appreciated abroad. Consequently, the United States has for some time received all of the best star sapphires, and some of the finest deep blue stones ever seen have found their way to this country. The star of a star sapphire consists of six (or really three intersecting) rays of light seen in the depths of a rounded stone. The star made by these intersecting rays moves as the stone is placed in different positions. Seeming to be almost a living thing, the floating star has quite understandably been held in awe by primitive peoples.

The mineralogist points out that the star follows in its three directions the six-sided outline of the original hexagonal corundum crystal, and explains that it is due to the reflection of the light beam from the sides of three sets of parallel rods or tubes. These microscopic inclusions are scattered all through the gem but are invariably parallel to the crystal's structural directions; hence, the sum of the reflected rays always reveals itself as this six-pointed star. When a single direction exists in a stone, we get a cat's-eye, and if but two directions are represented we get a cross, as in some garnets. Six-rayed stars are common in rose quartz. Realistic imitations of the true star sapphire have recently been made from hemispherical quartz gems by coloring the bottom blue.

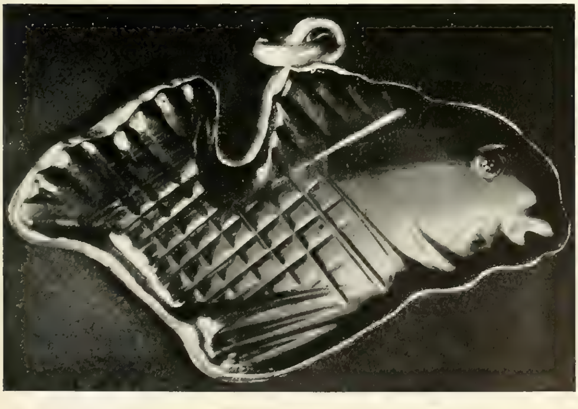
Sir Richard Burton is reported to have put a star sapphire to good use in his travels. In return for assistance rendered him by the natives for food, lodging and care of his animals, he gave them the privilege of gazing upon his star sapphire and deriving from it all of the good fortune supposed to ensue.

Sapphires were regal gems worn by kings to protect them from harm. Later they came to be regarded as ecclesiastical gems whose pure color was symbolical of the heavens. This most sacred of all gems was endowed by nature with great power. Sapphire was supposed to be as strong an antidote against poison as the emerald. The mere sight of a sapphire was said to kill spiders.

Most star sapphires come from Ceylon, but the best colored Kashmir blue stones are found in India. Australia, North Carolina, and Montana have all yielded some sapphires. However, the demand is principally filled by the Eastern countries. The best qualities are characterized by a velvety blue color, the shade known as cornflower blue being the most desirable. Some stones, notably those from Australia, turn dark, almost black, in artificial light and are less valuable than those of the Kashmir quality.

Other sapphires also change color in different lights; for instance, a stone which is blue in daylight becomes violet in artificial light. These stones are known as alexandrite sapphires, because the variety of chrysoberyl known as alexandrite changes under similar circumstances, but from green to red. Stories have been told of tests of virtue made with such a stone, under conditions predicated to bring about a desired result. Wearing of the stone for a few hours in daylight would bring no change, but as usually applied such a test could not end before dark, so a condemnation was certain when the stone was inspected by candlelight. It is to be hoped that victims soon learned for themselves some of the wonderful properties of this interesting September gem.

(*Right*) Blue-tipped yellow sapphire crystal from Ceylon



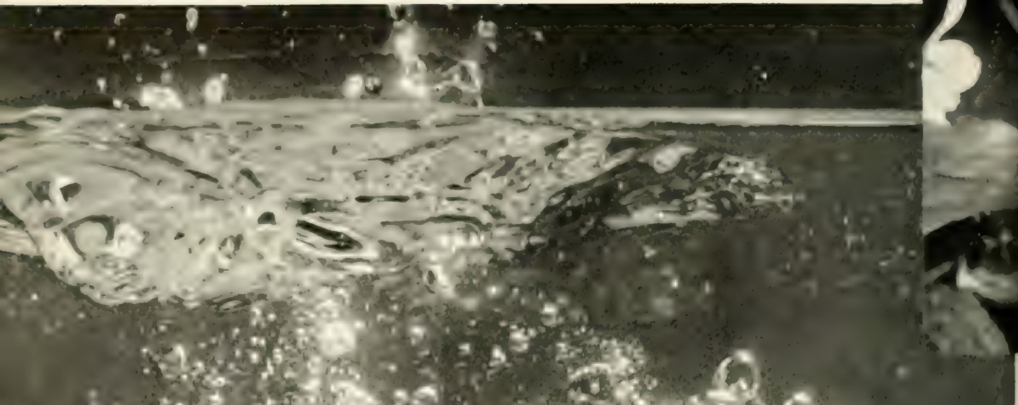
Carved sapphire fish with ruby eye. Light parallel bands across tail are characteristic of the genuine stone

All photos AMNH by Coles

SEEING NATURE *through the* CAMERA'S EYE

By HENRY B. KANE

Underwater Bubble Dance of a Frog



A Bumblebee Takes Off

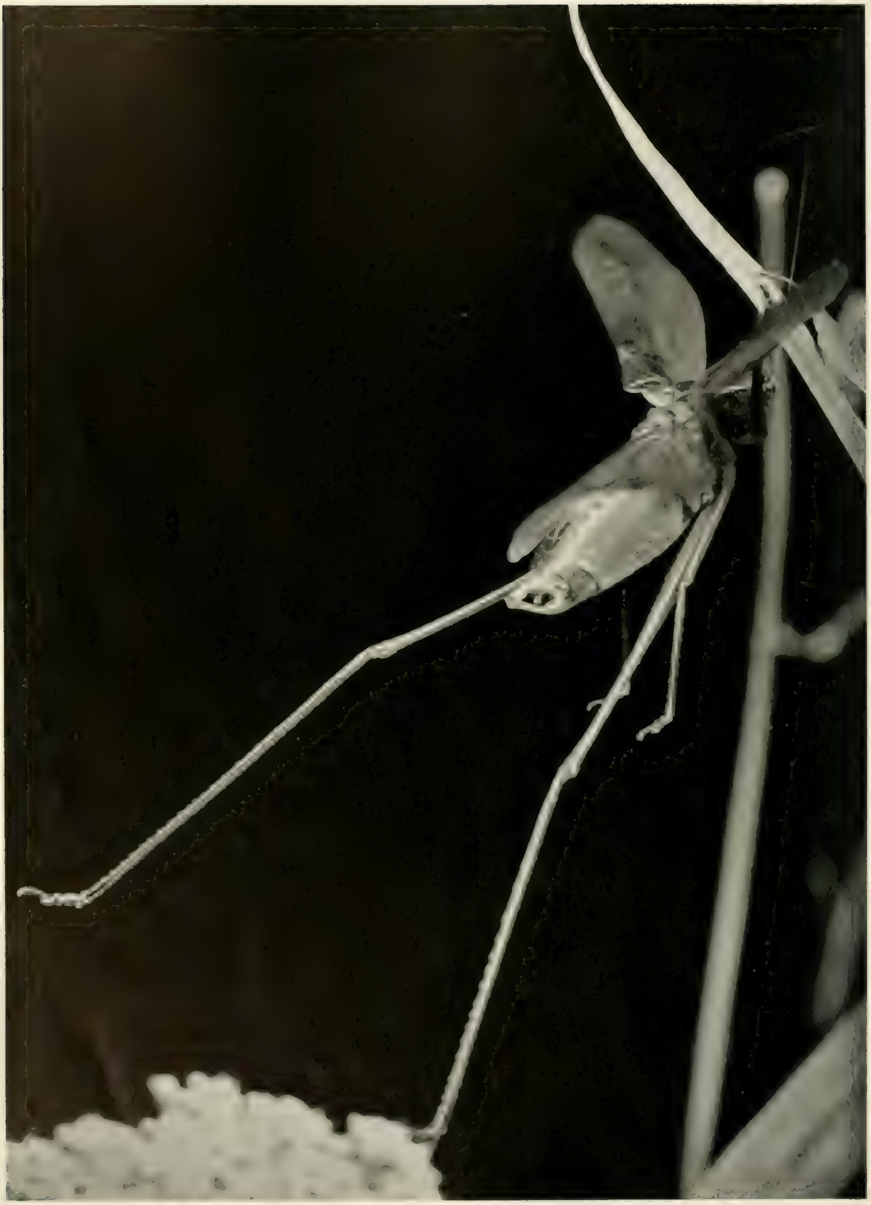
. . . and Lands—a 30,000th of a second photograph

Up Periscope

STILT JUMPER

—A Katydid caught at a 30,000th of a second

Henry B. Kane Photo



Songster and Dancer Unrivaled

By R. T. LITTLEJOHNS

Spectators who are unmoved by any other form of bird life stand spellbound before this gorgeous creature of the Australian forest

All photographs by the author, through Camera Features

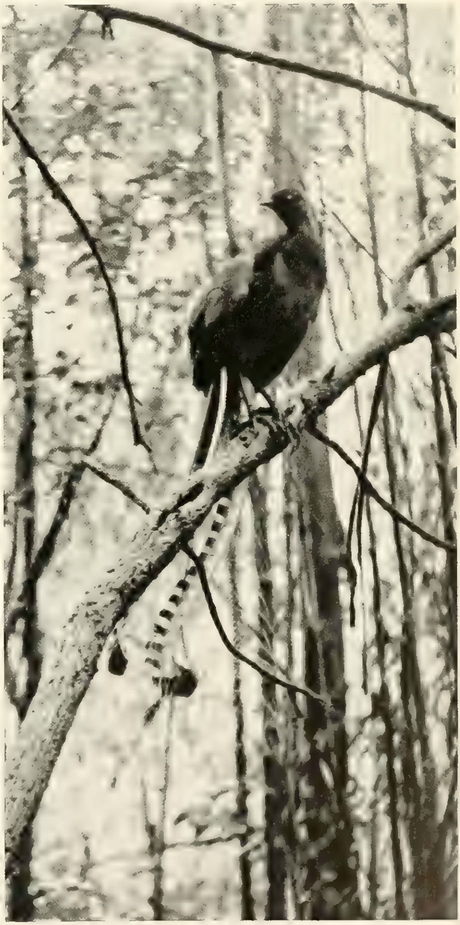
ANY description of the fauna of Australia would be incomplete without reference to the lyrebird, which has emerged from comparative obscurity of a few years ago to become almost a national idol. In the last decade the attitude of the Australian public toward the wildlife of the country has changed most noticeably, so that we find almost every species of animal and bird increasing in numbers—even those which had appeared to be faced with extinction. Amongst those in greatest danger of extermination were all three of this country's most remarkable creatures, the koala, the platypus, and the lyrebird. The survival of the koala is not assured even now, as its numbers have reached that dangerously low level from which recovery is difficult. But the lyrebird is safe in those wide areas of mountain forest which, being unsuited to cultivation, may remain in the wild state indefinitely.

No apology is made for placing the lyrebird amongst the foremost natural history attractions of Australia. It is, without doubt, the greatest Australian songster and, in addition, is probably the most efficient of all mocking birds. Then there is the romantic dancing ceremony performed by the male bird on small cleared patches or "mounds," surely one of the most attractive natural history spectacles to be seen anywhere. With all these accomplishments to its credit the lyrebird undoubtedly would become more popular even than the koala were it not for its wild and elusive nature. This same elusiveness, however, ensures that the "artistry" of the species never will become commonplace.

The early history of the lyrebird is recorded in several books published soon after the advent of white man in Australia at the end of the eighteenth century. In these writings it was described variously as a pheasant and as a bird of paradise. Actually it is not related to either of these, nor to any bird found in any other part of the world. Even in Australia it is restricted to a narrow strip of country extending 1000 miles down the eastern coast of the continent,—roughly from Brisbane south to Melbourne.*

Both male and female are dark-colored birds about the size of domestic fowls. The head is small, the neck slender, the legs strong, and the feet enormous. The sexes are alike except with regard to the tail. In the female the tail is long but is composed of feathers of orthodox design. The tail of the male, however, besides being larger than that of the female, is a most attractive ornament and is what gives the bird its

(*Below*) WORLD'S BEST imitator: the Lyrebird, whose lyre-shaped tail befits one so musical. Its amazing voice masters almost every forest sound from the laugh of the "laughing jackass" to the rustling feathers of a flight of parrots



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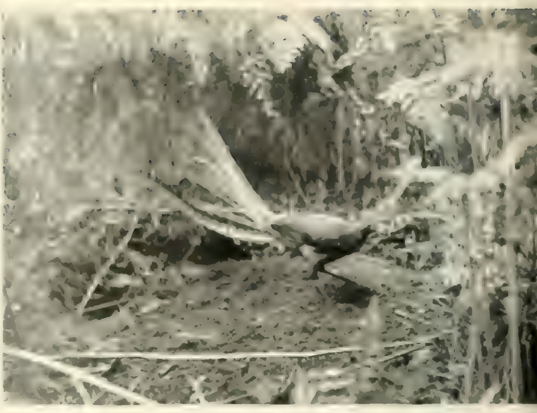
*Modern ornithologists recognize two species of lyrebirds, both residents of Australia, the one under discussion being the Superb Lyrebird, *Menura novaehollandiae*.—ED.

[illegible] dark colored, so that in its normal folded position [illegible] all the feathers, however, are silvery white, the broad outer ones being marked with bars of bright chestnut. The conspicuous undersides of the feathers are displayed during the dance, and it is only then that the full beauty of the tail becomes apparent.

The lyrebird lives almost entirely on the ground, using the trees only as roosting places at night. Worms, grubs, and beetles form its staple diet and are unearthed by industrious scratching in the soft mold. In this process the large, powerful feet are used to move quite heavy sticks and logs and to rake the undergrowth.

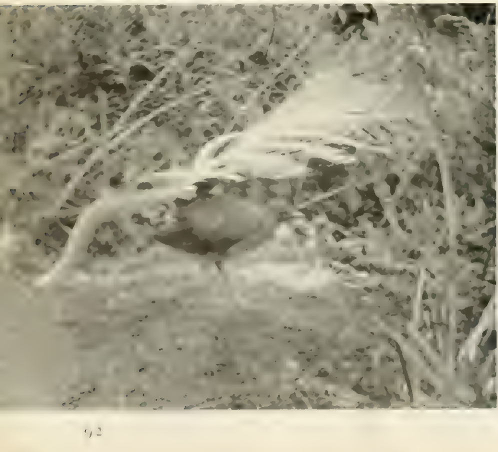
In April, at the beginning of the Australian winter, there is much activity among the male lyrebirds. Debris is cleared from old dancing mounds, or new ones are made where none had been before. Each male lays claim to a certain definite territory, over which he feeds and beyond which he seldom wanders. Within this territory he may make almost a score of mounds, on any of which he may decide to perform as the spirit moves him. In order to make a new mound it is often necessary to remove fern stems up to six feet in height, and great ingenuity and tenacity are displayed by the bird in carrying out this self-imposed task.


THE DANCING of the male lyrebird on his dancing mound is even more wonderful than the song and is experienced less often. In constructing his mound, the bird often has to remove six-foot fern stems, and shows great ingenuity and perseverance

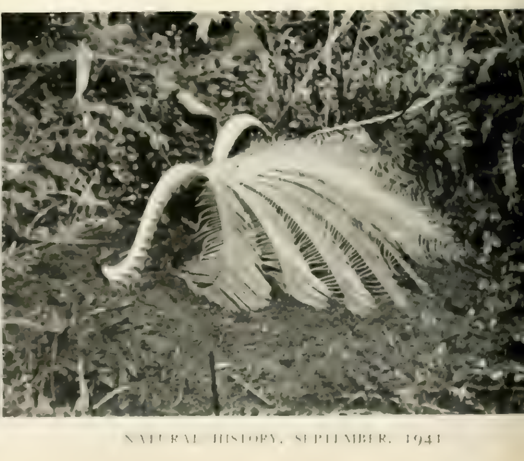
During the months of deepest winter the male lyrebirds fill the forest with melody practically from morning till night. It is at this season that the dance may be most often witnessed by those who are sufficiently interested to brave the discomforts of the sodden forest and to exercise a reasonable degree of patience.

The vocal powers of the species are remarkable and are without equal, at least in Australia. This largest of all songbirds produces a volume of sound so penetrating that the song may be heard clearly from a distance of a quarter of a mile. At a distance of 20 or 30 feet the louder notes ring uncomfortably in the human ear. The song is in part original, in part a faithful mimicry of bush sounds, and for the re-

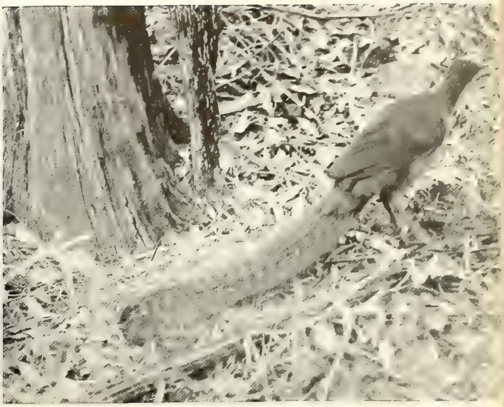
GOING INTO HIS DANCE. Suddenly there is a change in the song, and the bird sweeps his tail upright, to fall reversed over the body,—a gleaming silver fan



THE performer at times "shivers" the fan rapidly, causing it to resemble a miniature snowstorm. He faces here to the right



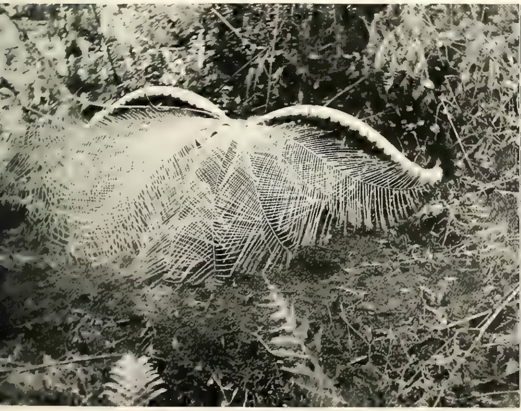
In April the lyrebird clears off old mounds or builds new ones, to the number of almost a score. He performs mostly in well-screened positions, making photography extremely difficult



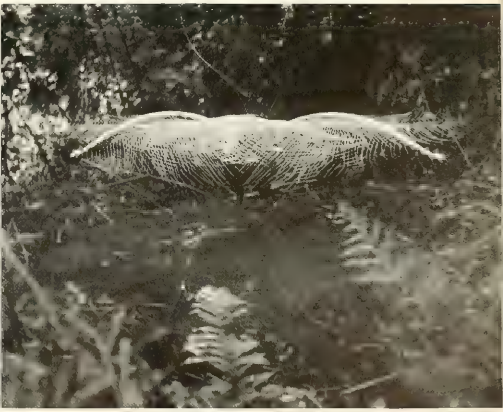
When folded, the tail is well camouflaged and gives no forewarning of the sensational display to come. The lyrebird lives almost entirely on the ground

mainder it consists of semi-original items based on the songs and calls of other birds. The mimicry is indescribably faithful, the wonder of it, of course, being more fully realized by those who are best acquainted with the birds whose songs are imitated. Every inflection in the song of the original is reproduced with exactness, so that it would be impossible, by the sound alone to detect the deceit. The raucous laughing of the kookaburra (the Australian kingfisher, known as the "laughing jackass") is rendered with the same facility and faithfulness as is the high-pitched musical whistle of the pilot bird or the feeble scolding treble of the thornbills. Even the rustling of feathers, such as accompanies the flight of a flock of parrots, is reproduced in the wonderful throat. Again, the mimic may imitate the call of the boobook owl, a nocturnal sound, and the fidelity with which the peculiar "throatiness" of the original is imitated is uncanny. But undoubtedly the greatest accomplishment of the master mimic is the rendering of a whole chorus of kookaburras laughing in unison. The kookaburra provides much inspiration for the lyre-

Rhythmic notes mark time to the lyrebird's dainty dance, as he approaches the camera in full display



A final burst of beauty rewards the photographer, as the song dwindles to a wheezing rattle and ceases

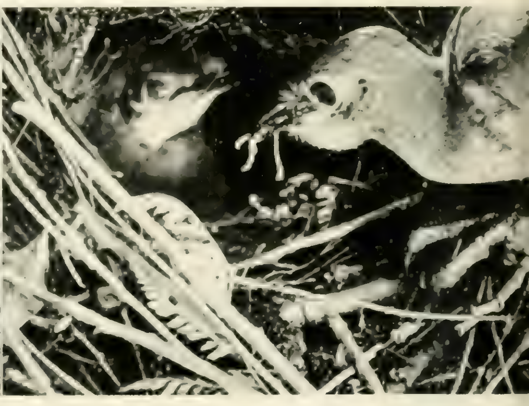


(*Left*) FROM THE NEST of the female, this scene shows a tree-fern gully typical of the forest in which the lyrebird makes its home

(*Right*) A FIVE-WEEKS-OLD lyrebird, left alone in the nest, wonders what it is all about, as Mr Littlejohns' camera records another phase in the life of Australia's greatest songster

(*Below*) THE mother lyrebird about to feed the chick. She is solely responsible for hatching her single egg and caring for the chick, which is blind when hatched

FEEDING: a remarkable photograph at 18 inches. Mr. Littlejohns spent ten winters making two cinema films. An electric buzzer accustomed the birds to the camera



(*Below*) HUMPBACKED, long-legged, and pinfeathered, the six-weeks-old chick has just left the nest, to follow its mother with tottering footsteps into the forest,—the homely premonition of a gorgeous creature

bird at all times, but just once or twice in a lifetime does one hear the chorus so elaborately and faithfully sung by the mimic that one must simply gasp in amazement. It is useless to attempt to describe this performance. It is wonderful beyond description.

Of the semi-original sounds, the most notable is an elaboration of the song of the gray thrush, which almost always drifts into bubbling notes suggesting the distant laughing of kookaburras. These two calls combined form a stanza of great beauty. Even in the midst of its feeding, the lyrebird frequently pauses to utter just this one call.

When the male bird settles down seriously to singing, he visits one of his several mounds or stands on a log or limb. Here he may give a performance of half an hour or longer practically without pause. In that time there is not a dull moment. Calls are repeated, to be sure, but the sounds reproduced are so many, so varied in tone and in volume, that the song is a complete entertainment.

The dancing of the cock on his dancing mound is even more attractive than the song. It is, in fact, always accompanied by singing, but, being performed usually in well-screened positions, it is witnessed less frequently than the song is heard. Anyone who witnesses the dancing ceremony is unlikely to forget the experience. Scores of people who are not particularly interested in natural history have become so absorbed in the artistry of the lyrebird that they may be found, week end after week end, at Sherbrooke Forest, near Melbourne, a place famous for its lyrebirds. During fourteen years devoted to a study of the species, the writer has witnessed the "dance" on many hundreds of occasions, yet its romantic interest thrills him as deeply as on the first occasion. It is unfortunately almost impossible to record the dancing ceremony adequately by photography. Certainly the motion picture is more efficient than any other method, and for this reason the writer spent ten winters making two cinema films. The more recent one, completed a few years ago, was made for the Australian Commonwealth Government and has been shown frequently overseas.

A gleaming silver fan

The highlight of the dancing spectacle is the transformation scene which marks the commencement. Usually the cock sings for some time with his tail folded. During this phase the tail is inconspicuous, as its upper surface is almost uniformly dark in color. Suddenly there is a change in the character of the song: the notes become wilder and perhaps less musical. Then the display starts and with an unhurried sweep the tail is raised upright and allowed to fall reversed over the bird's body. With the same movement the sixteen feathers spread fan-like, until the performer is hidden almost entirely by it. But it is no longer a tail of somber brown. With the sweeping movement the ornament becomes a gleaming fan of silver.

Determined, apparently, to ensure that its new beauty shall not pass unnoticed the erstwhile placid singer becomes at once a creature of great animation. Whilst the performer adopts a rhythmic sideward marching the tail may be "shivered" rapidly, so that the whole assumes the appearance of a miniature snowstorm. Then there may be curious jumps in regular series of two to the accompaniment of loud, challenging notes. There may be rapid circuits of the mound or, for minutes together, the snowy fan may be still, except for the vibration caused by the fervor of the singing.

After minutes have slipped away to a score or more, the song dwindles to a wheezing rattle and ceases. The wonderful tail rises to reveal the artist once more, and the feathers are folded so that their beauty is departed in a moment. There will be the invariable final shaking of the plumage as the actor steps from his stage to stride with dignity into the ferns.

The domestic life of the lyrebird is in keeping with the other remarkable phases of its existence. It is one of the few male birds in Australia which takes no part in the domestic activities. The female builds, unaided, the large nest of sticks and fibers. She also performs all the work of incubation and feeding of the chick in the nest. It may be said, in excuse for the cock, that his large tail would render the performance of some of the domestic routine difficult in the extreme.

The nest is bulky and is built almost always on or near the ground. With an exterior shell of fairly large sticks and an inner lining of fern fibers, the home is a substantial domed structure so faithfully constructed that, even in the depth of winter, it is always warm and snug within. One egg only is laid each year. It is thick-shelled and rough, varying in color from light purple to dark stone and is roughly the size of a hen's egg. The period of incubation is about six weeks, which appears extraordinarily long. Receiving no assistance from her mate, the hen, since she herself requires a great quantity of food, often leaves the egg unattended for several hours a day.

The chick is blind when hatched and is covered, except on the neck and underparts, with sooty-colored down. Because it has no brother or sister with whom to share the food brought by an attentive parent, it grows rapidly. At the age of a couple of weeks it is able to signal resentment, when disturbed, by uttering a blood-curdling scream. At five weeks the chick has grown so considerably that it lifts the roof of its home in excitement when mealtime approaches. At this stage the gawky youngster has little claim to beauty, nor has it improved when, a little later, it tumbles from its threshold and follows its mother with tottering steps into the forest. For some time thereafter its history is obscure. It is not known with certainty how many years pass before the chick, if a male, attains the full ornamental tail, but it is certain that for at least two or three years he carries a long but unpretentious tail similar in every way to that of an adult female.

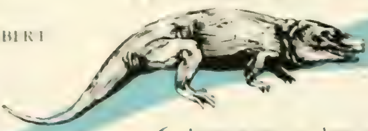
THREE ANIMALS T

By EDWIN H. COLBERT

[illegible]

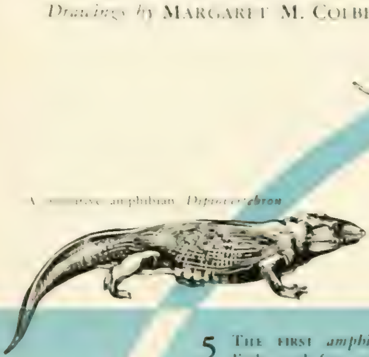
Drawings by MARGARET M. COLBERT

A primitive reptile, *Seymouria*



6 As TIME went on there was a gradual transformation from amphibians into the first *reptiles*. No longer was the land-living vertebrate bound to his ancestral watery habitat, for the reptiles laid protected eggs that could be hatched on land

A primitive amphibian, *Diplovertebron*

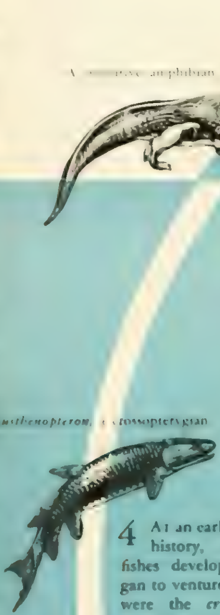


LAND

WATER

5 THE FIRST *amphibians* had limbs and feet, transformed from the fins of their crossopterygian ancestors. Although they could walk across the land they were dependent upon water, for only in the damp marshes where they lived could their eggs be hatched

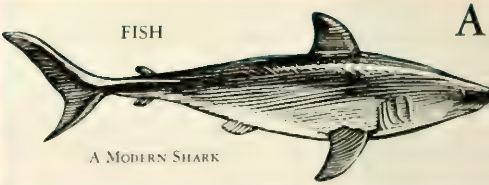
Eusthenopteron, a crossopterygian



4 AT an early stage in vertebrate history, certain fresh-water fishes developed lungs and began to venture out on land. These were the *crossopterygians*, the ancestors of the amphibians

3 DURING the long passage of geologic time, the modernized *sharks* evolved from their acanthodian ancestors. The result has been the perfection of the streamlined body form for swift, sustained swimming in the open ocean *(below)*

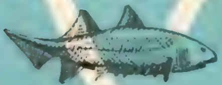
A



A MODERN SHARK

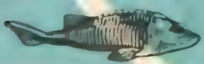
2 FROM the ancestral jawless vertebrates the first true fishes developed. These were the spiny "sharks" or *acanthodians*, freely swimming fishes adapted to life in the open water *(left)*

Climatius, an acanthodian

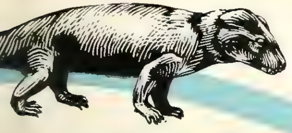


1 THE FIRST known vertebrates were small, jawless, fishlike animals called *ostracoderms*, living on the bottoms of ancient rivers and estuaries *(left)*

Cephalaspis, an ostracoderm



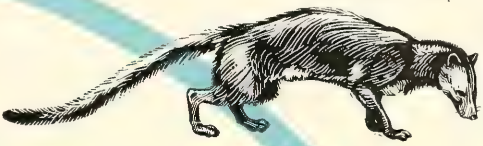
HAT WENT TO SEA



A mammal-like reptile, *Cynognathus*

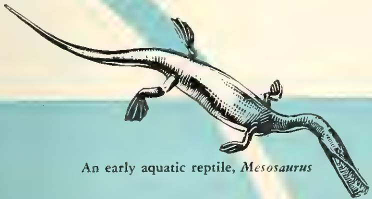
9 YET the main trend of reptilian evolution was confined to the land. Certain reptiles, like *Cynognathus*, having descended from primitive types, became very progressive, or mammal-like

RTAIN REPTILES, finding the uggle for existence on land fficult, began to return to ter to live. Thus in the aquatic reptile *Mesosaurus*, iginal trend of evolution ater to land was reversed



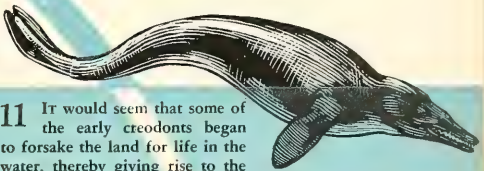
A creodont, *Sinopa*

10 FROM these mammal-like reptiles the early mammals evolved. The transformation of reptile into mammal was marked by the change from a cold-blooded to a warm-blooded circulation. Among the early mammals were meat-eaters known as *creodonts*



An early aquatic reptile, *Mesosaurus*

11 IT would seem that some of the early creodonts began to forsake the land for life in the water, thereby giving rise to the primitive *zeuglodonts*—the ancestors of the modern whales, porpoises, and dolphins

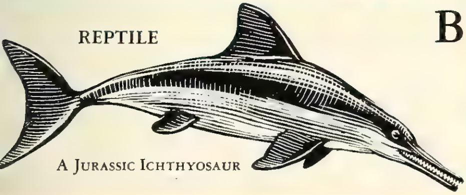


A primitive whale, *Zeuglodon*

8 *(Below)* THE CULMINATION of this reversal was reached by the *ichthyosaurs*, which although descended from land-living reptiles became thoroughly fishlike in body form—the result of streamlining

REPTILE

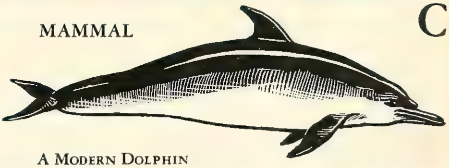
B



A JURASSIC ICHTHYOSAUR

MAMMAL

C



A MODERN DOLPHIN

12 AGAIN there had been a reversal in evolutionary trends, reaching its culmination in the modern *cetaceans* (whales and their relatives). Descended from land-living mammals, the cetaceans have become secondarily fish-like, streamlined for life in the ocean, as seen in the dolphin above

By roundabout routes involving 300 million years of evolution, three widely different classes of animals perfected an amazingly similar streamlined design when they met the conditions of life in the water

To the museum visitor, wandering through halls where ten thousand wings are folded and spread in multicolored hues, where Africa silently lives far from the sun-baked veldt, where the mammoths march in impressive array and where the great dinosaurs once again rear their mighty forms, the life of the world may seem to be bewilderingly complex. Nature's outstanding trait is the diversity of her children. Yet a closer study reveals that there is often a beautiful simplicity in many of nature's basic designs, and the resemblances that occur time and again in varied and unrelated forms are just as striking as the differences which are so apparent at first glance. For evolution is not only the development of many different kinds of animals or plants from a few primitive ancestral types, but also the parallel or convergent development of superficially similar organisms from different ancestral forms.

As an illustration of the latter let us look at three animals of different ancestry which at different times in the earth's history went to sea and partly because of their life under a common environment came to resemble one another. This particular type of evolutionary development is called "convergence" or "parallel [illegible] the upland plains, to the ponderous, aggressive rhinoceroses of the veldt and jungle, and to the water-loving tapirs of the tropical forests. Conversely, through convergence, unrelated animals which develop under similar environmental conditions may become superficially similar. Such is the case with the three animals that went to sea, the shark, a fish, the ichthyosaur, an extinct reptile, and the dolphin, a mammal.

The similarities in these three animals are the evolutionary result of physical laws which set definite limitations upon the manner in which life may develop. A good flying mechanism, whether it be bird, bat, or airplane, must have wings for support in a rarified medium; while an efficient underwater mechanism, whether it be fish, porpoise, or submarine, must be streamlined in order that it may slip easily through a very dense medium. That is why there are perhaps no better examples of convergent evolution than among those animals that inhabit the sea, for an aquatic existence imposes physical limitations that are very definite. Let us first review briefly the beginnings of evolution among the vertebrates, or backboned animals.

It would seem that all life began in the water. (The transfer from the protection of an aquatic environment to the vicissitudes of life on land came long afterwards in the evolutionary story.) Therefore it is not surprising that the earliest backboned animals of whose fossil remains are known were aquatic animals. These early vertebrates, which are called ostracoderms, were fish-like, yet they weren't actually fish, for they had not yet reached a true piscine dignity. They lived on the bottom of ancient rivers and estuaries, grubbing in the black mud of the shallow waters for their food. They were for the most part flattened of head, flexible of body, heavily armored and provided with a single pair of appendages projecting from the corners of their plowshare-shaped head shields. There were no lower jaws; instead, the garbage-like fare which nourished these ancient vertebrates was sucked in, vacuum-cleaner fashion, through a round mouth on the underside of the head. From this crude beginning, the animals with backbones evolved.

At a very early date the first true fish appeared, swift-swimming, primitive "sharks" adapted to a life in the open waters. And with their appearance the basic architectural pattern, so characteristic of almost all of the vertebrates, was established.

An aquatic animal, to be an efficient sustained swimmer, must conform to certain physical requirements of design. The body must be elongated and streamlined, with a rather rounded head, with the thickest part of the body a short distance behind the head, and from thence tapering to a point at the rear. This is the true streamlined design so [illegible] achieved by man in his mechanisms. The propulsive force of the well-designed water animal is supplied by alternating undulations of the body pushing backward against the water, thereby forcing the animal forward. In addition to the propulsive force, there must be an efficient control of movement and balance, which is accomplished among fishes in part by a series of fins: a pair on either side near the head (the pectoral fins), a pair on either side farther back on the body (the pelvic fins), and median fins along the back (dorsals), along the under surface of the animal (the anal fin), and at the hind tip of the body (the tail or caudal fin). This is the basic pattern for the jawed vertebrates, first established by the early sharks of lower Paleozoic age, some 400 million years ago.

In these early sharks the backbone extended through the upper part of the long, tapering body to the base of the tail, where it made a sharp, upward bend, to extend into the upper lobe of the tail fin. This primitive tail pattern, known as the heterocercal tail, is still preserved in the modern sharks. A widely gaping jaw, armed with numerous sharp teeth, large paired fins and well developed dorsal fins complete the picture of these primitive streamlined vertebrates,—evidently fast swimmers, swiftly gliding through the open waters of the ocean in pursuit of their prey. From a pattern such as this evolved the tremendous variety of modern fishes, culminating in such advanced models of the streamlined body pattern as are to be found in the modern mackerels and perches and their relatives, some of which are among the fastest swimmers known.

But such highly specialized fishes and their kind did not evolve rapidly. There were long geologic ages after the first appearance of the primitive sharks before these highly specialized bony fishes finally reached the height of their structural evolution. And in the meantime other animals with backbones were developing along other lines.

Toward the middle or the latter part of the great Paleozoic era, certain freshwater fish began to venture out on land, to try a new mode of life. The movement from water to land involved profound bodily changes; indeed, this new departure in animal life called for an almost revolutionary series of adjustments. In the first place, a new method of locomotion had to be developed in the land-living animal, for no longer could the body be utilized for pushing against a dense, watery medium. Secondly, the animal on land had to cope with a force heretofore of little consequence,—the constant downward pull of gravity. No longer was it buoyed up by the medium in which it lived. Also, it had to effect a new method of breathing: oxygen must be extracted from the air, not from water. Fourthly, the animal had to guard against drying up through the process of evaporation, which obviously was of no consequence to the water animal. Finally, it had to develop new methods of reproduction, whereby the eggs could be protected from the rigors of dryness and temperature consequent upon emergence from the water.

All of these new conditions of life were successfully met by the land-going fishes mentioned above, and thereby the first amphibians came into being. The paired fins of the fish, originally directing and balancing organs, were transformed into limbs for propulsion, while the dorsal and anal fins, no longer needed, were lost. The tail, originally part of the propelling apparatus, became in turn a long balancing lever. Thus the functions of the fins and of the tail were in a sense reversed in the change from fish to amphibian. The gills were reduced or lost, and lungs served for breathing. The backbone became strong to support the weight of the animal. The skin was kept moist, to prevent a drying up of the body, and reproduction was made possible by a return to the water for the laying of the eggs.

As time went on, certain of these amphibians developed a new type of egg, which could be laid on land, and new body scales were evolved to guard against the drying effect of the air. Thus the first reptiles were born, the forerunners of a large and varied group of animals that were dominant on land, in the water, and in the air for the great stretch of geologic time known as the Mesozoic era, or the Age of Reptiles.

Early in the Age of Reptiles—that period when the great dinosaurs dominated the land—certain reptiles returned to the waters to follow their fortunes. Here is where we see the remarkable effects of convergent evolution taking place. These animals, as they became ever more closely adapted to their watery environment, grew constantly more fish-like in their outward form. The body became torpedo-shaped and smooth, and the flexible neck of the land animal disappeared. The tail grew long, and around its extremity a new tail fin was formed. In this development of the new tail a curious change took place whereby the backbone extended and bent downward to enter the lower lobe of the tail fin. Here was formed a new heterocercal tail, but one that was a mirror image of the primitive heterocercal tail of the ancient sharks. The limbs, originally derived from fins, were again transformed into fins. A new dorsal fin grew on top of the body. The snout grew longer and became armed with numerous sharp teeth,—a return to the fish-catching type of mouth, first developed in the primitive sharks.

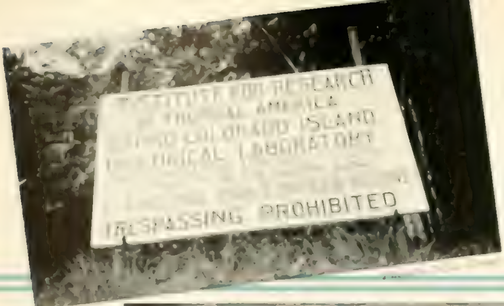
Thus the ichthyosaurs, the marine reptiles of Mesozoic times, whose ancestry can be traced from primitive fishes through the amphibians to land-living reptiles, returned again to the sea, and in doing this they became once more streamlined and fish-like.

"Fish-like" they were, but they were not fishes. Evolution had completed a circle, and there had been an apparent reversal in its trend; yet there was no real reversal, for structures once lost can never be regained. The ichthyosaur had become fish-like in form but by virtue of a transformation of head, body, and limbs from those of the typical land-living reptile, and by the manufacture of a completely new tail and a new dorsal fin. And although the ichthyosaur lived a fish-like existence, it breathed by means of lungs, inherited from its land-living grandparents. Such are the obvious clues to convergence in evolution as against a direct hereditary relationship. The resemblances are present, but the family history shows them to be of completely different origin. Through the long process of evolution, physical laws had imposed likenesses through mutation and selection upon unrelated animals living in the same type of environment.

Time elapsed,—the ichthyosaurs lived, evolved, and finally passed from the earth. In the meantime some of the land-living reptiles, living at the same time as the early ichthyosaurs, had given rise to a new type of vertebrate, the mammal. Certain reptiles through transformation produced animals that were warm-blooded and active, animals that were protected by a coat of hair, instead of reptilian scales. These new creatures gave birth to their young instead of laying eggs and suckled their young on milk; they were the mammals, the class of animals that includes most of our modern wildlife of forest and plain.

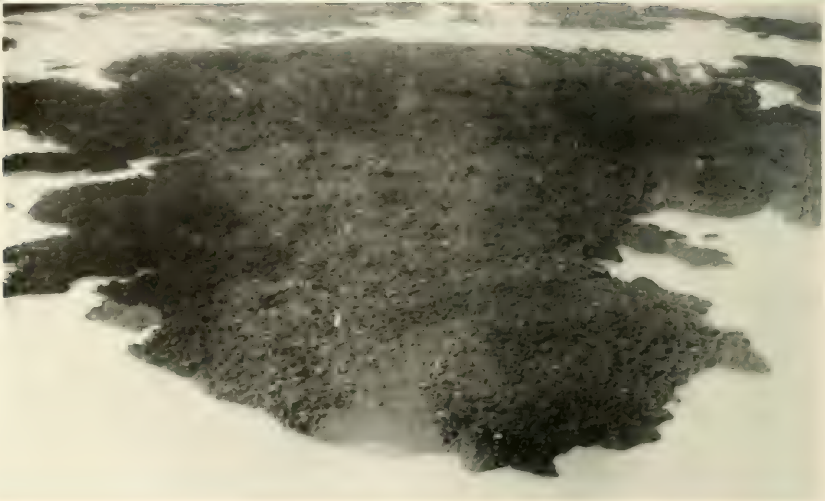
The early mammals lived on land, as had their reptilian ancestors. But at a fairly early stage in the history of the mammals, one group like the ichthyosaurs before them, took to a life in the open waters of the oceans. And once again the streamlined body form came into being, without relation to its earlier manifestations in fish and ichthyosaur. The body lengthened and became torpedo-shaped. The hair was lost and the surface of the skin became smooth. The flexible neck of the land animal disappeared. A new

Continued on page 112



A Naturalist'

By E. THOMAS GILLIARD



THE native cayuco glided beneath the walls of towering trunks which leaned precariously in a haze of sifted moonlight. A big, dragon-like iguana, observing my silent approach, let go its footing high in the trees overhead and plummeted with a nerve-wracking explosion into the black water ten feet ahead of the prow. Crocodiles, which by day are so rarely in evidence as to seem almost mythical, were all about. Their brilliant ruby eyes, the danger signals of the night, reflected blindly into the beam of our searchlight. The fantastic howls of black howling monkeys made one shudder as they resounded from the crown of the forest. This was Barro Colorado by night.

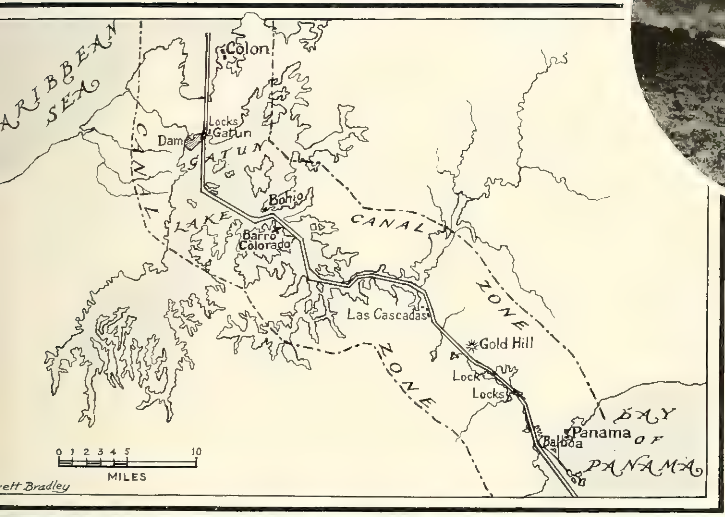
As I paddled on silently through the black waters of the vast, man-made Lake Gatun which forms part of the Panama Canal, the "Chief," Dr. Frank M. Chapman, kept up a ceaseless search of the banks, hoping to spot the eyes of the tapir we had set out to find. This animal is closely related to the large rhino, and besides being the biggest of South American mammals, with the exception of the inland porpoise, it is probably the best swimmer. Our hunt was futile, but as we were returning up the darkened inlet toward "Fuertes House"—our hospitable cabin deep in the jungle—a raucous series of whistles in several pitches broke forth from the giant trees on our left. This wood rail concert, sounding like a quartet of bagpipes, aroused some fond memory in Doctor Chapman, and before I could grasp the motive, he stood up in the precarious cayuco and began directing the "orchestra." There he stood with an imaginary baton leading the chorus from our dugout, and there was I, so amazed my mouth hung open.

Although the wood rails are usually silent, seclusive birds of the deepest jungle, they are quite vocal when their little-known mating dances take place. These dances occur when a sprightly male struts on his long legs out into his little clearing in the dead of night and puts on a song and dance to lure the more venturesome of spouses to his particular domain. The females, usually several of them, vie for attention by joining the chorus, which rarely lasts for more than a few seconds. But the Chief had stolen the show as far as I was concerned.

When we returned we sat on the steps for a long while, listening to the many noises of a tropical night, and I slouched against a post, puffing my last pipeful. It is astonishing how much noise the multitudes of living things around us produced. Off on the hill the

Mecca in the PANAMA CANAL

Barro Colorado's island laboratory lies at the crossroads of two hemispheres. Students of Nature have gathered here from all over the world to make biological history amid its tropical wildlife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Photos by Frank M. Chapman

(*Extreme left*) AN AIR VIEW of Barro Colorado, a thickly forested island rising out of man-made Gatun Lake. Its tower looks out on ships like that above, passing along the great inter-ocean waterway, its jungles echo to the cry and bustle of a rich Central American fauna which found sanctuary here when canal builders flooded the environs

(*Below*) LABORATORY and camp, including Frank M. Chapman's famed "tropical air castle." The celebrated ornithologist is one of Barro Colorado's most regular visitors

(*Below*) A TROPICAL forest, 165 square miles in area, was submerged, making Gatun Lake one of the least navigable in the world

[illegible] of a large [illegible] repeated [illegible] [illegible] [illegible] little [illegible] the [illegible] of a big tree [illegible] [illegible] [illegible] Overhead [illegible] with their [illegible] could be heard the [illegible] and [illegible] perhaps a mile distant, the [illegible] of the [illegible] howling monkeys. A [illegible] like the scream of a struggling woman that it never failed to shock me, joined all of these sounds in a *[illegible]* serenade. But there were other more subtle noises, each telling its own particular story, which I, with my four short months of experience, could not fathom. The Chief, sitting there on the steps, often explained them to me,—explanations which were quickly delivered from the vast store of experiences gathered over a period of almost half a century of study and keen observation of animals, both here and in almost every country in South and Central America from Mexico to Tierra del Fuego.

I had read about Barro Colorado in Doctor Chapman's books and in his articles, and had hoped, like so many other young men, that some day I might see this mythical, tropical isle. But until a certain incident occurred six months before, I had never dreamed this longed-for boon would ever come my way.

A premature snowstorm was raging outside of Whitney Wing of the American Museum of Natural History when my phone rang. It was the Chief. I remember wondering what I had done wrong to warrant this summons to the sanctity of his "sanctum sanctorum." About five minutes later I stumbled out of his office in a daze. It would have taken Joe Louis to do a better job. You can guess what happened and shortly thereafter I bid adieu to the vast collection of birds and mothballs and embarked with Doctor Chapman for the fabled Central American island.

Introduction to Barro Colorado

Seven days later in the blaze of a tropical sun and fanned by the cool Caribbean trade winds, we completed the last leg of our trip. Although we'd kept our business to ourselves on the way, it seemed that everyone knew "The Doctor." From the time we had boarded the good ship *Ancon* and gone down to our staterooms, where the Cockney cabin steward had greeted Doctor Chapman like a long-lost brother, our business had become increasingly the property of the curious passengers. Doctor Chapman was the "mysterious American scientist" who annually shipped all the way from New York, only to go into seclusion out on that jungle island for from four to five months.

On the dock where we landed we were hailed by Chichi, out-island boatman and warden, a sinewy little Latin whose knowledge of the channels and dangers of Lake Gatun was of inestimable value, and Fernando, a wary old bushman. Half an hour later the little inboard cabin yacht struck out through the placid *estero* toward the Panama Canal.

Here and there huge dead trees, killed when the Chagres Valley was flooded to form Lake Gatun and a major part of the inter-ocean waterway, protruded like the masts of derelict ships from the lake surface. Following the narrow open waterway, we rounded the bend and came upon a large body of water with big, slashing waves. Straight ahead, perhaps a half mile distant, were two big red and white buoys, and to our right, hardly a mile away, a tremendous ocean liner was bearing down on us. She was throwing big waves and heading for the buoys. We cut our motor and drifted till she crossed our bow. The ridiculousness of the scene made me laugh. It seemed as though I were looking at a toy exhibit in Macy's window. The big ocean vessel was cramming itself through a tiny mountain lake and soon disappeared around a bend no wider than Broadway. We crossed the Canal near Buoy 44, about midway between the Atlantic and Pacific, and headed speedily toward a low whaleback hump of land. The waves were throwing a spray completely over us as Doctor Chapman shook my shoulder and yelled a few words, pointing out a red cliff near the right tip of the island. "The island Barro Colorado is named for those cliffs," he said. The name means "red clay."

The gushing Chagres, whose channel lay 80 feet below the cliffs, had been, in pre-Canal days, a dangerous leg in the old trans-isthmian trail, a cruel, overland route which had seen many a strange and pitiful sight. From the days of Balboa's discovery of the Pacific up through the California and Alaska gold rushes, it had served as the fastest means of inter-ocean travel. Sir Henry Morgan and his band of cutthroats twice passed by the big, flaming cliffs during their march and retreat from the bloody siege of old Panama. The very name—Barro Colorado—was first recorded in connection with Morgan's advance, for in 1670 Captain Louis de Castillio, the commander of the Spanish forces sent to oppose Morgan, established a camp under these cliffs. "But," to quote Doctor Barbour, "he retreated before the boats bearing Morgan and his men arrived, leaving a record of valorous discretion."

Barro Colorado itself is a mere dot on the map of the Panama Canal Zone, lying about midway between the Caribbean and the Pacific,—an island where the wild animals are considered to be the only permanent and worthwhile residents, and where man is entirely secondary. It was set aside as a permanent base for the Institute of Research in Tropical America under the jurisdiction of the National Research Council in Washington.

The island was formed when the Chagres River was dammed by the largest earth dam in the world in order to raise the river level 85 feet. The lake thus formed was slow to fill, four years being required to inundate the 165 square miles of tropical forest now forming its basin. During the flooding, animals of all descriptions which had lived in the vast Chagres Basin had to move to dry land, and Barro Colorado, being the largest of the islands formed by the rising waters, naturally received a goodly portion.

I don't want to convey the impression that this island is either a wild circus or an island Ark, especially since Barro Colorado did not become an island until the lake had risen almost to its highest level. Furthermore, the rumor has gone around that this island is inhabited by hordes of wild animals; and when the Resident Manager, Mr. James Zetek, takes visitors out to it, they are sometimes disappointed. Naturally when a group starts noisily through the woods it is not going to see many wild animals. On the island there are, nevertheless, more than 1400 species of plants and trees, 231 species of birds. Its mammal population consists, to mention a few, of the puma, ocelot, Baird's tapir, collared and white-lipped peccaries, four species of monkeys, the white-tailed and forest deer, two species of sloths, and tamandua tayra, the coati, and agouti, etc. Essentially it has changed little from its primeval state, and probably every species of animal which in recent times had frequented it, with the possible exception of the spider monkey and perhaps the jaguar, was there when the island was set aside as a wildlife refuge. If all goes as planned, this zoologists' mecca of the tropics will remain intact, and eventually it may be the sole domain of some of the animals which now dwell in Central America.

For things have changed a great deal in Panama and in the Zone since the Army engineers first went into that fever-infested area to make it fit for the workers and engineers who came to build the Panama Canal. Today there is no fever on the island and one can sleep out at night, though elsewhere in the Zone this is not recommended. This has been made possible by Mr. James Zetek, the Resident Manager, who was one of the original biologists who fought the scourge of malaria and yellow fever before the construction of the canal. He periodically examines all the help and prohibits them from being in Frijoles after dark. Actually the "modern conveniences" in this primeval jungle are now so luxurious that one cannot help feeling paltry compared to the men who pioneered in this region and in South America. Men like Schomburk, Bates, Cherrie, Belt, André, Wallace, and even the Chief. All these men had invaded the tropics when they still were deadly—even before quinine was known except to the Dutch and to the Peruvian Indians who first discovered it.

Howling monkeys

We had hardly reached the last of the 186 steps which led up from the trim little wharf, when Doctor Chapman, panting from the climb, broke out in a hoarse exclamation, "Howling monkeys—the whole clan's over my house!" Sure enough, 40 big, black creatures were traveling high in the crown of a huge balsa tree bedecked with white, vase-like blossoms.

At sight of us they let out a series of roars, which sounded like the bellowing of a dozen lions. We watched them as they methodically crossed from tree to tree out of sight into the jungle. I was most intrigued by the way in which the females conveyed their young, who clung precariously from their backs as they scurried through the maze of quivering limbs, sometimes jumping fifteen feet and more with a grace born of complete confidence.

Doctor Chapman's house, his "tropical air castle," was a perfect example of simplicity in the extreme: a sixteen by eighteen foot box, with a single partition, set on nine cement piers, one open and one screened porch, and a tin roof. I'll admit I was somewhat abashed at sight of this famous castle set at the edge of the jungle and painted green so as to be hardly distinguishable.

My quarters were on the porch of the laboratory, and I had a small table, a cot, and a magnificent view. Work, if you can call it that, began immediately. Hours were from 6:30 A.M. until it was time to go to sleep. Every five or six weeks we had a holiday visit to Balboa and old Panama.

Day after day and week after week, spending never less than seven hours in the jungle, almost always alone, I gradually came to know and accept the wonders of Barro Colorado. At first, I didn't venture very far into the tunnel-like system of trails. Every 20 or 30 feet some new, unnamed creature, flower, or insect, would arouse my curiosity, and out would come the pencil and notebook. Evening after evening the Chief would identify these varied subjects of my curiosity.

I well remember my first trip into the jungle. It was a slow and methodical affair, and contrary to popular imaginings, I didn't find it teeming with [illegible] and up[illegible]. A[illegible] that [illegible] the [illegible] [illegible] would have greatly impeded my progress and I lost the trail [illegible] a few steps. It was pleasantly cool under the roof of green, which sometimes attained a height of from 100 to 125 feet, and even 150 feet, as it reached out pleadingly into the sunny and [illegible].

My field notes describing those first impressions are as follows: "Somehow this island jungle took on the quiet majesty of an endless cathedral. Very few living things were seen, but I confess that my untrained eyes were [illegible]. I was conscious of [illegible] thousands of them, in a vast assortment of sizes and colors—focused on me, but I couldn't break through their shield of protective coloration to verify this feeling. Occasionally I was allowed a glimpse of [illegible] flying feathers only after the creature which had been watching me as I tiptoed through its domain, had satisfied its curiosity. Big guans, the wild turkeys of the jungle, screamed and scolded and took wing, a grouse-like tinamou flushed from the leaves at my feet and shot off through the timber; and always I could be certain that the inhabitants for hundreds of yards in every direction had been warned of my approach. Only a parade of leaf-cutting ants, each with a bit of fresh leaf twice their size, [illegible] hoisted overhead like a green sail, seemed determined to ignore me. I was absorbed in watching them marching along a well-cleared path, half as wide as this page and apparently endless (it was at least a quarter of a mile long) when off to my left, less than 30 yards from where I was seated on a low, gnarled strangling fig of the sort that entwines about trunks and eventually squeezes the life from trees larger than most of us have ever seen, my attention was attracted by a noise like the snapping of little twigs and the rustling of crisp leaves. Small shadowy figures darted about on the dark floor of fallen debris, and suddenly a long-legged brown bird with an incredibly short tail hopped up on a log and surveyed me. The rustling became louder and more confusing, and more of these thrush-like ant birds gathered in a "wave" around me. Soon thousands, literally thousands of insects of every description—spiders in all sizes, big lumbering beetles, and even a half-grown tarantula—

Doctor Chapman *(above left)* offering a banana to "José," a coati immortalized in his writings. *(Above right)* Native cayuca and paddle. More seaworthy than a canoe, this craft is admirably suited to noiseless observation of animal behavior along the shore

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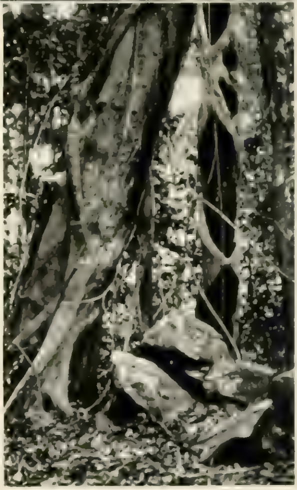


On these and following pages appear some of the creatures and plant-forms whose fascinating interrelationships have made Barro Colorado a world center of zoological research. At right, a strangling fig has crushed the life out of a balsa tree. Termites quickly devoured the dead wood, leaving the curious natural "scaffolding" of the lethal fig. The tree at left has evolved a fearsome set of spikes, possibly as protection against the depredations of animals were seen scurrying along in my direction. Caterpillars climbed to the tops of small stems, paused, and then dove back down into the leaves as if in fear of their lives; bugs and more bugs sprinted across the trail and into the dense mass behind me, and all the while the five species of Formicariidae (ant birds) gorged gleefully on this mob of insane little creatures. Following on their heels were the advance scouts of what turned out to be a mass hunting expedition of black army ants. They were scouring every niche and every tree to its topmost branches, killing all manner of insects. In less than 20 minutes the show had moved out of earshot; and as I sat quietly, a little green tree snake, which had been resting motionless on a branch a few feet in front of me, slithered down to the ground and disappeared."

The reptile population of Barro Colorado is very secretive and perhaps unusually low owing to the large numbers of peccaries, which are reputed to make short work of snakes. During my stay I saw very few—a boa, an *Oxybelis* tree snake, a palm viper, a brilliant coral snake, and the green tree snake just mentioned.

Specifically it was my job to trap and band turkey buzzards and black vultures, to run a line of flash cameras in order to get a photographic record of the large mammals, and to make a survey of the nesting habits of as many species of birds as I could discover. One of these, the beautiful rose-breasted and green iridescent Massena trogon, was the bird directly responsible for a field trip to the north side of the island.

Some days before, guided by the soft, plaintive *que-que* distress note of the Massena trogon, I had come upon a needle palm tree close to the water, which the trogons fitfully defended. Watching stealthily, I discerned that both the male and female were engaged in the excavation of a tunnel in the side of a termite nest eighteen feet above the ground. When the Chief heard of this he lost little time in packing equipment and departing for the spot. We stayed ten days while he made a life-history study with many photographs of this rare species.

At first, when Doctor Chapman had turned the two Nesbit flash cameras over to me, I had thought myself quite a trapper, but the months rolled by with mediocre success. I had taken one of these

Photos by Frank M. Chapman

THREE-TOED SLOTH *(left)*. He plays host to a unique species of moth that dwells in the green algae infesting his back. Recent scientific experiments have shown the sloth to be glandularly incapable of swift flight or sudden action. By contrast, the raucous black howler monkey (*right*) is spryness personified

(*Below*) YOUNG JACANA. Though too young to fly, this bird can make his way over lily pads with astonishing celerity. At full growth he will be little larger than a robin, yet his talon-spread will exceed the span of a horse's hoof

Photo by E. Thomas Gilliard

[illegible] Alfred M. [illegible]

STRIKING SHOT of a Brazilian cormorant (*above*) perched on a dead tree limb in Gatun Lake. Two hundred and thirty-one species of birds have been identified on Barro Colorado

(*Right*) NESBITT FLASH camera and apparatus, with which naturalists secure trip-wire exposures of the Island's night life. This automatic camera may be left in the jungle for weeks at a time and, with luck, will catch such big game as the stalking puma (*below*), and the ocelot, tapir, and white-lipped peccary on the opposite page

s by Frank M. Chapman

THE IMPUDENT young marmoset (*above*) is really quite camera-shy, and what appear to be ocelot's whiskers (*below*) are actually rootlets of the stilt-palm in background

(*Above*) A NATURAL submarine who generally comes ashore only at night. South America's largest mammal, the tapir, scales as high as 500 pounds. Yet he is as elusive as a loon

Photo by E. Thomas Gilliard

(*Below*) A WHITE-LIPPED PECCARY. Right, author Gilliard forcibly takes the wingspread of one of 22 turkey buzzards he measured and banded. His data showed fifteen and a half square inches of wing area for every ounce of body weight

Photos by Frank M. Chapman

[illegible] the [illegible] [illegible] "[illegible] House" at the [illegible] that I would find a [illegible] [illegible] on the far side of the island who hadn't already heard of me, and one day I set out to examine my set with [illegible]. The camera, a rather complex affair, weighing about fifteen pounds, was set alongside a huge log where I had found some "cat-sign."

A set is made in the following way: the aluminum-boxed camera with fixed tripod is aimed at the spot where you suspect and hope the animal will pass, usually about eight feet from the lens and never more than 20 feet from it. The lens is focused, and the diaphragm set at f:6.3. The speed is 1/200th second. The Nesbit is designed for glass plates, which are inserted into the back of the camera in a film holder and then sealed into the aluminum case by means of a clamp and rubber-gasketed lid. Two two-ounce capsules of flash powder are set in flash trays on either side of the camera, and when fired they sound like the double charge of a 12-gauge shotgun. One of these is fastened to a little piston placed under it so as to catch the recoil of the exploding powder and drive the plunger of the shutter release. Thus when the animal bumps into the delicate trip wire causing the flash powder to fire, the impulse which takes the picture is exerted precisely at the height of the flash. Almost every other day I would find that the camera had been tripped, and each time that I took the glass plate back to camp, mixed the fluids for developing it and, after going through the agony of waiting in the stifling darkroom for eight minutes while I gently bathed the plate, I would find that I had another dud. Actually I am sure that I have the largest collection of pictures of falling leaves and twigs in existence.

At length things took a turn for the better. I finally got a good photograph of an ocelot, only the third ever taken on the island; but the pumas were all too smart for me. It had been my plan to set two of the cameras over the same trigger, one close to it and the other about 20 feet back,—the idea being to hook them up in a series so that the one farther away would fire about a tenth of a second after the first. By so doing I thought I might obtain some fine action shots, but the Chief would not hear of it, because as he said, "It would only be adding injury to insult."

Treetop lookout

"Some years ago," he continued, "I started out to build a portable tree house, thinking that it would be handy to use in connection with the Nesbit flash cameras." His idea had been to rig up a light wire platform, cover it with mosquito netting, and suspend it high in the jungle roof over one of his sets. The [illegible] [illegible] was too heavy and cumbersome, and the idea had unfortunately come to nought. The scheme appealed to my adventuresome spirit, and shortly after we returned to the laboratory I began construction. I cut some bamboo and bound it into two rectangles, each about the size of a cot. The bottom one was covered with strong chicken wire, and the other served as the roof. Ropes served as the uprights, and the whole was covered with netting. The sum total of my efforts resulted in a light net box which was collapsible but which, when stretched by the single half-inch supporting rope, opened up into a little house. I cut a tiny trap door in the bottom and hung a 30-foot rope ladder from it.

All the time I was putting the contraption together, the Chief was offering suggestions and, in no subtle way, allowing as how it "wouldn't be safe or worth while." He didn't come right out and order me to cease my foolish antics, but I fear that he felt that the idea was a little precarious. I, however, was completely sold on it. I wanted to hang the house 50 feet up in a big almendro tree that sprayed out over a large hog wallow about three miles from the laboratory. I could tell from the splashed mud and the muddy trail leading from this wallow that a big flock of white-lipped peccaries used this trough of sand and mud to wallow in. Since I had never seen them in it by day, I suspected that they visited it in the dark of night. It was my plan, therefore, to set a flash camera in the wallow and to spend the night in the tree house where I could listen to them and to the other animals which might pass by, either below or above.

All went well. I took the house out and hung it high in the tree. I set my camera and even cut some of the lower branches away so that I could direct the rays of my five-cell light down onto the wallow. When I returned to the laboratory for supper, the Chief was already eating his portion of fried plantains, rice, and corned beef. It was dark and very quiet outside, just the weather for a storm, and I frankly wasn't in any mood to reconsider; but I could tell from Doctor Chapman's apparent nonchalance that he was rather apprehensive. I don't know whether he was aware of some lurking danger not worth chancing or whether he just felt that I might fall out of the tree house, but at length, after supper, he retired to his house with a solemn "Good night."

Later, as I passed his house on my way to the jungle, his light went on, and I heard his voice calling. Going back, I was openly amazed at his offer. "Why don't you take my pistol with you, Tom?" he asked. I had never even suspected that he had a firearm! He then told me that he had taken a photograph of a puma directly under the spot where my little house was now hanging. "Better take it," he persuaded. "You won't need it, certainly, but it may make you feel better." I turned it down. Indeed, I probably would have been in more danger with a strange gun on that dark, slippery trail than without it.

All went well until I reached the top of the first steep incline near the junction of the Snyder-Molino and Tom Barbour trails. Had I flashed the trail ahead I would have seen at least two collared peccaries standing stock-still, watching me. As it was, they did not move until I was within three feet of them; but then, with a lunge of fright, they ripped through the underbrush perilously close to my feet. I lost ten years in that second! Incidentally, there are two species of these animals on the island: the white-lipped and the collared peccaries. The last is comparatively harmless, but the former is capable of inflicting serious injuries with its long, sharp tusks.

For a long while I sat in my eyrie, chin on knees, listening, and I remember too that I prayed that the howling monkeys would keep their distance that night. Only the day before, I had been discovered by a treeful of black howlers. Being well aware of their harmlessness, I lay down on the trail and focused my eight-power glasses on a huge male directly above. The cussed old rascal barked and roared and glowered while we looked each other in the eye. His ugly face, Gargantuan in horribleness, was adorned with three open sores which he periodically scratched. I must say that the great box-throated creature had an unfair edge. Through my glasses, he seemed to be only an arm's reach away and eight times actual size. Then by means of an indecipherable signal, perhaps a change of tone, the entire group broke forth in a peal of raucous thunder which reverberated all around me. It seemed that thousands of monkeys were surrounding me—on the ground, behind me, everywhere. I leaped to my feet when the din became unbearable and, as excitement raged, stomped off a little foolishly.

Not alone

Yes indeed, I thought, as I sat in my little mosquito-proofed platform, I could do without the howlers tonight. A rapping "tap-tap," similar to the digging of a downy woodpecker, striking with irritating regularity at the trunk behind my head, kept on and on, A weevil under the bark seemed to be the only explanation. There was a rasping of something ten feet out in the dark, which was mere emptiness in the beam of my light, perhaps the result of a fickle wind and an indecisive palm leaf. A honey bear twice crossed noisily through the crown of my tree before I caught him in the ray of light and identified him as a "straw-colored raccoon with prehensile tail." The endless noises, so many of which were strange and intangible, all combined to keep my vigil tense. I sat wide-eyed, feeling somewhat as a penguin must feel on his first night in a zoo.

Heavy plodding, coming in my direction, brought me into instant action. I waited for the cameras to boom, but suddenly the animal caught my wind, stopped dead and stayed motionless for at least a minute. My beam missed fire, and with heavy crashing and thrashing the big, clumsy animal, perhaps a tapir, crazed with fear, made off into the dense underbrush.

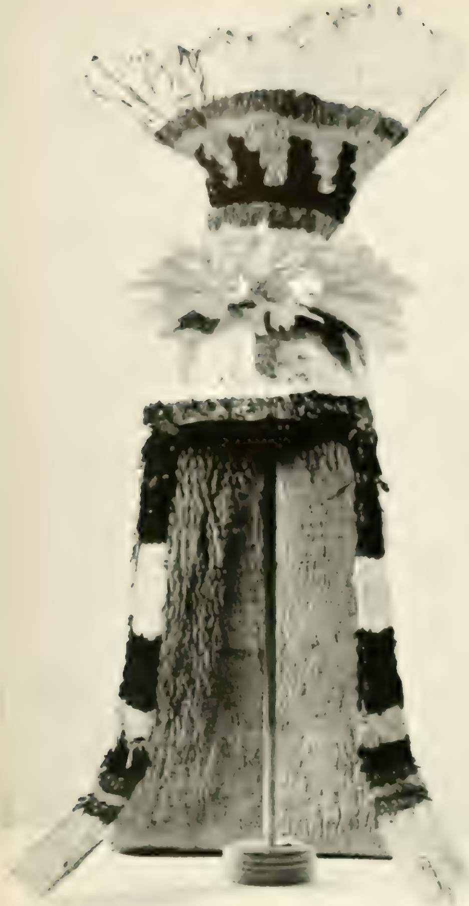
To my chagrin, it rained twice, each time in full view of the thin moon which hove up out of the black about 3:00 A.M. Each time it rained in sheets for about ten minutes, while I sought shelter under my pants and the blanket. Ticks, hungry little devils which could crawl through the netting, advanced on me in droves. Pending the coming of daylight and revenge, I let them get a hold, only to stop their infernal crawling hither and yon.

It was impossible to steal even forty winks with all of these visitors enjoying my hospitality and with the multitudes of other unknown quantities filing away at my nerves. I wanted to greet the coming of day, the awakening of the jungle, and I wanted to be back at the laboratory in time for breakfast. This last was a "must" on my list, because if there is any one thing that could make the Chief boil, it was being late for this first meal, which was always served at 7:00 A.M., Sundays and holidays included. And the fact that he had had to roust me out several times during the preceding month hadn't made matters any better.

The sun was beating down in slender shafts. People were yelling and my bed was swaying. I awoke slowly, gazed in a vacant, uncomprehending stare, and suddenly fathomed it all.

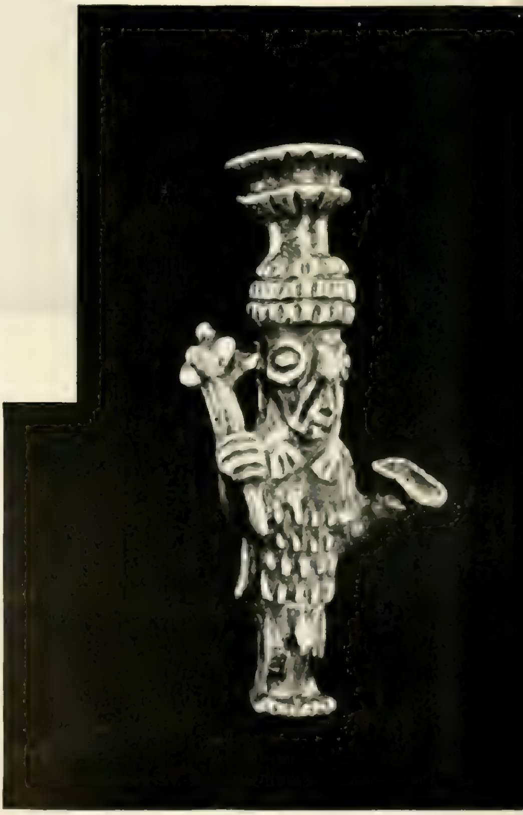
"It's eleven o'clock and the Chief is very, very mad," Chichi yelled at me.

Fernando gawked up at me and mumbled something in Spanish to the effect that they had had a "hell of a time finding me." I didn't doubt either fact as I streaked back to camp. A new day had begun at Barro Colorado, and I had already missed a good part of it. A new day in this unusual island, which is a world within itself, seemingly removed in time and space far from the world of man, yet a spot which becomes a part of everyone who has lived in it and comes back to fill your mind long after you have left it.



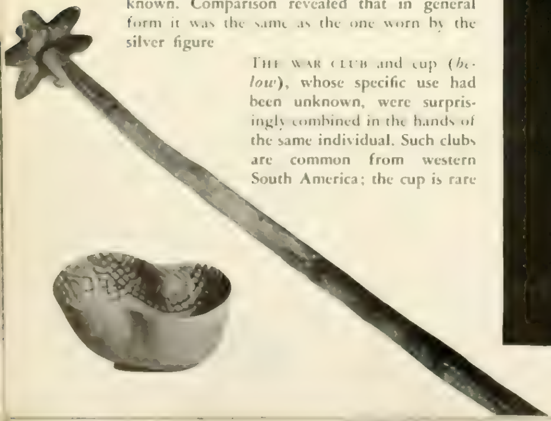
The Mystery of "THE TAX COLLECTOR"

(*Below*) THE SILVER STATUETTE from Peru which shed light on the feather headdress, war club, and cup



WHEN the feather headdress above was found in a mummy bundle, its use and age were unknown. Comparison revealed that in general form it was the same as the one worn by the silver figure

THE WAR CLUB and cup (*below*), whose specific use had been unknown, were surprisingly combined in the hands of the same individual. Such clubs are common from western South America; the cup is rare



NOTHING is certain save Death and Taxes. If this gloomy aphorism applies to cultures other than our own it may lend color and meaning to these ancient Peruvian artifacts, recently put on exhibition in the American Museum.

In 1896, the small silver figure (*center*) found its way into the Museum. The archaeologists of that day knew only that it was Peruvian. All efforts to divine what manner of man the pre-Columbian silversmith had intended to portray were pure speculation. Accordingly it was filed away to await further data.

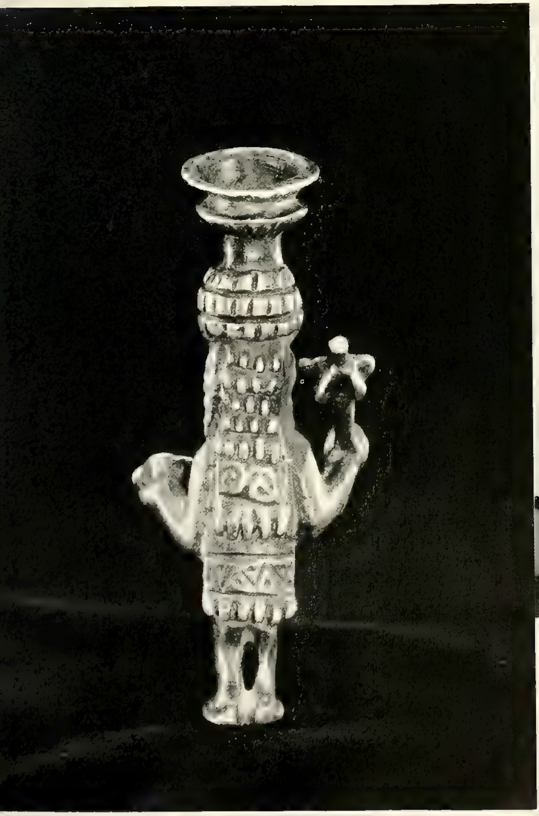
Thirty-seven years went by before the feather headdress shown at extreme left and right arrived. It, too, was catalogued and shelved,—purpose and period unknown. Then one day when Junius Bird, the archaeologist, was taking inventory of the 50-year-old South American collections, he noticed the similarity between the actual headdress and that worn by the silver effigy. Before long he had sifted out three other items, illustrated at the bottom of the page: the war club and the cup (*lower left*), and another portion of the headdress (*lower right*),—all of which correspond to the articles depicted in the original silver figure.

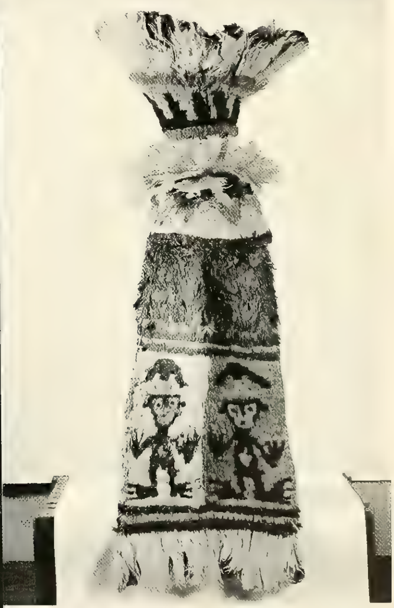
Thus was the patient method of archaeology rewarded. After more than 40 years, scientists reached a denouement whereby several individual "mysteries" mutually explained one another. The functional interrelationship of each stands revealed. But the function of the man who once wore these feathered robes of state and carried club and cup in either hand, remains unsolved. We can only guess that the cup may have been a receptacle for contributions of some sort while the stone-headed club might have been used to threaten recalcitrant "contributors." Indeed, the figure has humorously been dubbed "The Tax Collector," and—who knows? Time and future specimens may prove the jest a shrewd one.

ONE-HALF of the figure symbolizes Force, the other Begging. Together, they may well represent a "Tax Collector"

The design on the back of the cape is different, but another similar specimen, at bottom, has the same scroll

All photos AMNH by Coles





THE MYSTERY OF THE TAX COLLECTOR

[illegible] shifted. But this time it was horizontally placed, not vertical as in the fish and the ichthyosaurs. The limbs of the land-living mammal [illegible] transformed, [illegible] becoming fins or flippers of which only the forward pair remained useful. The typical mammal's limited, diversified teeth, which had come from the unlimited simple teeth of the earlier vertebrates, again became secondarily simplified and more numerous, to form a fish-catching mouth similar to that of the fish and of the ichthyosaur. Thus the porpoises, dolpins, and whales appeared. Once again the circle had been completed.

Once again evolution had shown a reversal in trend, yet had maintained its basic irreversibility. Again—as in the case of the ichthyosaurs—the porpoises and dolphins and whales, though fish-like, were only an approach toward the fish type, for they were warm-blooded mammals, not cold-blooded like the fish and like the reptile. And no matter how thoroughly fish-like the body might become in adjustment to a life of rapid swimming in the ocean, these were still mammals that continued to give birth to their young and to suckle them on milk, just as their land-living ancestors had done. The whales had become pseudo-fish while retaining those important inner structural and psysiological features that distinguish them as mammals. They had become fish-like in outward form, as had the ichthyosaurs, because life in the water, through the working of definite laws of physics, enforces the adoption of streamlining for the sake of efficiency.

In this story of fish, ichthyosaur, and porpoise, we have seen that strict environmental requirements can cause convergent evolution and result in a unity of form among quite unrelated animals. The story is there as clear as a well-limned picture, traced by the long series of fossils appearing in the successive strata of the earth's surface and by the living descendants known to us in the flesh. And the methods whereby the story unfolded are being made increasingly clear by studies of the laws of inheritance and selection in modern forms of life.

Yet familiar as the tale may be, even the specialist can never get over his wonderment at the workings of nature in accord with these laws through the immensity of geological time. He can never quite reach a state of being blasé about the remarkable adaptations wrought in various animals under the physical limitations of their environment in their long struggle for survival. And the more casual student of nature, who may discover for himself other instances of convergence growing out of the basic conditions of life, will sense an unsuspected harmony and order in the life of our planet, and he can never cease to be impressed and delighted with the object-lesson in evolution which they teach.

DO NOT MISS

SEA ELEPHANT'S HOME-COMING. Unique because of a proboscis that reaches ten to twelve inches the sea elephant is one of the most remarkable members of our native fauna. His return to former breeding places near the Pacific Coast once more tempts scientific research and observation.

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WE LIVE IN AN ICE AGE. The glacial period is still with us! These are soul-stirring times geologically, as well as politically. For a popular survey of glaciers and their significance to man, watch for this article by Weldon F. Heald, beautifully illustrated.

●

Right in the center of the northern part of the Pacific, and a few minutes east of the International Date Line, lie Midway Islands, bird sanctuaries which are among the most unusual places of their kind on earth. **THOMAS M. BLACKMAN** spent nearly half a year in this bird metropolis, which supports at least two unique species. His report in story and picture will excite the interest of ornithologist and layman alike.

THE TRUTH ABOUT TERMITES—Labeled public enemies number one by exterminating racketeers, these "white ants" (which aren't ants at all) are seldom destructive in civilized communities and definitely constructive in nature. Incidentally, some species can't digest wood any better than we can

By FRANK E. LUTZ

Curator of Entomology, The American Museum of Natural History

TERMITES, popularly called "white ants," are neither ants nor even closely related to ants. In addition to a large number of structural differences between ants and termites, there is the important difference in life-history that ants hatch from the eggs as worm-like creatures and go through a pupal stage before becoming adults, while termites on hatching from the eggs look much like small adults (except that no newly hatched insect ever has wings), and they have no definite, apparently lifeless pupal stage in their life-history. In other words, ants have "complete metamorphosis" and termites have "incomplete metamorphosis." I suppose that there is no real objection to calling them "white ants," provided we remember that they are not ants and that winged ones are not white. They will be called "termites" here.

All termites belong to the order Isoptera and all Isoptera are termites. If we say that they are related to roaches, we shall be not nearly so far wrong as when we relate them to ants. In fact, we might go as far as to say that they are "social" roaches.

It was formerly a surprise to many that termites may naturally occur in a New York City suburban yard. As a whole, they are a tropical group but there is one species that ranges northward to Maine; another gets as far north as British Columbia. A large number of the Eastern one, *Reticulitermes flavipes,* first found their way to our yard in a piece of firewood; and two or three blocks down the street there was a flourishing colony in what the children and I called the Presbyterian Hole. Disregarding a Biblical hint as to the inadvisability of starting a building without having the finances to complete it, our good neighbors of that denomination dug a cellar for a new church but never put in even a foundation. The hole that they dug was a fine place for a number of ground-inhabiting insects, and its depth, combined with a fringe of vegetation, made it possible for a man and his children to watch those insects without being watched by people on the street.

Termites are ant-like in size and they live in colonies, each colony usually being made up of the descendants of one female, a "queen"; but a typical termite colony differs in several important details from a typical ant colony. A great deal of information concerning American termites is given by Banks and Snyder in *Bulletin 108* of the U. S. National Museum; and Snyder has published an authoritative book with the somewhat fearsome title, *Our Enemy, the Termite.* You might consult these if you wish more than the following.

Some species of termites live chiefly or wholly in wood; others chiefly in the ground; and others, like our *Reticulitermes flavipes,* must have both earth and wood for their dwelling. Dead wood is the favorite food of most termites and, so, those that live partly or wholly in wood quite efficiently carve out their dwellings by feeding on them—they both eat their cake and have it. Since *flavipes* must have an earthen cellar to its house, stumps or fence posts or timber lying on the ground quite suit it; but it never damages buildings in which the lowest timbers are on sufficiently high solid concrete foundations.

A curious thing is that, although termites feed on wood, some of the species cannot digest it but depend upon Protoza living in their intestinal tracts for that important step in the process of changing dead wood into living termites.

Some biologists are given to dating the occurrence of one natural phenomenon by reference to another, instead of solely to a man-made calendar, Gregorian or otherwise. This plan is at least rather pleasing, whatever its scientific advantages or disadvantages may be. Thus, Snyder, in telling about the maturing and flight of young termite queens near Washington, D. C., refers to the blooming of flowering dogwood, which has, of course, no direct connection with termite queens but occurs at the same time as their spring flight. He says that when the flower buds of the dogwood were swelling the young queen termites were about ready to undergo the molt that gives them their wings; when the first few flowers had opened, a few recently molted adults were in the termite nests, when the blossoms were half out the winged adults in most colonies had attained mature pigmentation; and "by April 30 the adults had swarmed from colonies. Dogwood was nearly in full bloom." Fine!

I have started several times to keep records in this

This article is excerpted from the chapter "Termites" in the author's forthcoming *A Lot of Insects,* which G. P. Putnam's Sons will bring out in October.

[illegible] It is an excellent [illegible] and natural history, and I highly recommend it to others but suggest that [illegible] be [illegible] down on the side.

The swarming of winged ants is a nuptial flight: hundreds, sometimes thousands, of males and virgin females joining in a dizzy dance from which newly mated pairs drop out, the female to begin her humdrum existence in the darkness of some burrow and the male to die. Virgin honey bees have a nuptial flight but it is rarely noticed, a single female going forth without any rivals and returning entirely alone, she, too, leaving her groom to die. The bride among honey bees comes back to the home in which she was born. (What we call a "swarm" of honey bees is really a colonizing and not a mating flight. It is the mother and spinster daughters vacating in favor of a bride-to-be.)

The swarming of our termites is different from either of these. Males and many virgin females fly out together. There is more or less courtship during the flight but no actual mating then. Soon the females settle to the ground and shed their wings, the flight being over. If a female has been at all attractive, at least one male is with her and, after the wings have been shed, courtship becomes more energetic. Matters are finally arranged and the happy pair starts housekeeping, the male living to enjoy home-life. Female "sluggards," if such there be, among humans may consider the ways of real ants and be wise, but most men would doubtless prefer the ways of the so-called white ants, the blondes.

The family life of termites is extremely complicated. I shall not attempt to explain it to you in detail, largely because I do not understand it myself. Incidentally, no one else understands it fully.

The original queen of a colony of some tropical species becomes an excessively swollen egg-producing machine, her abdomen so large that she cannot drag herself about but lies in a special "royal cell," accompanied by one or more mates, the "kings," and attended by a horde of workers who feed her and carry away the eggs that she lays.

I like our *flavipes* better. Its queen goes about from one part of the nest to another. Like many other species, *flavipes* has two forms of individuals other than those whose primary function is reproduction. There are ordinary workers and also workers with, among other differences, large jaws. The ones with big jaws are called "soldiers." Snyder says: "The duty of the soldiers is apparently entirely protective, but they do not appear to be very effective, at least when the colony is opened and they are exposed to the attacks of ants, etc." So, there another good story goes bang! But, if not for protection, what are they for? Ornament? Possibly. Who knows? It costs much food to rear and maintain them but the same is true of human soldiers. Among ants, bees, and wasps the workers and soldier-workers, if any, are all females; but among termites either sex may apparently become either sort, depending on we know not what.

These things are complicated enough to suit the most energetic of puzzle-solvers but, as though to make it more difficult, there are three different sorts of reproductive individuals: "first form, second form, and third form." These are not very entrancing names but they are sufficient. Then there may be various kinds of intermediates, and so on. What are they all and why? If not "why," at least how do they come to be?

It seems that, in some species at least, if the original queen, a "first-form reproductive," dies, one or more of the "second-form reproductives" take up the work of laying eggs and, if all of the second-form reproductives die, then one or more of the third-form reproductives do the egg-laying. But, as long as there is a living first-form, neither second-forms nor third-forms function—abundantly, at least—and as long as there is a living second-form reproductive, none of the third-forms function. Furthermore, although a first-form can be the parent of all three forms, a second-form cannot produce a first-form (but can produce second-forms and third-forms, and a third-form can produce neither first-form nor second-form but can produce third-form reproductives.

Until more has been learned about this matter, it is perhaps just as well not to suggest explanations here. If things are as I have stated them, such a termite colony is, barring a major calamity such as running out of food, a perpetual affair. It may easily lose its original first-form reproductives, but the others can carry on.

I wish long life to the person who would learn all that there is to be known about the *Reticulitermes flavipes* that came to our yard in a fire log. Perhaps a study of that colony at the "Presbyterian Hole" would have revealed some of the things that were planned to be taught there when the hole was dug. But it is now too late. The property has been sold again, and the hole has been made a "sunken garden" full of things that are pretty but not particularly interesting because they are so artificial.

I have said, "It was formerly a surprise to many that termites may naturally occur in a New York City suburban yard." Popular opinion on that subject was changed by one of the most outrageous campaigns of false advertising and high pressure sales manship that has ever come to my attention in entomology. People who trusted newspapers, slick talkers, and writers of catchy letters for their ideas about insects were persuaded that their region had been suddenly invaded by termites; that not a house was safe from the attack of this horrible horde; that something must be done at once or the houses would come crashing down on the human inhabitants; that such-and-such a company could do this something at a cost that was high but not equal to the cost of the house, and that the company would guarantee on its "bond" that the house would then be safe for a specified term of years.

The facts are as follows:

There has been no invasion of termites. The species that is here now was here before Europeans, whatever their nationality may have been, first sighted American shores. Indeed, the same kind of termite was probably here long before there were human beings.

There has been no marked increase in the numbers of this insect except in the minds of the people who have recently been made termite-conscious by propaganda. Unless I am greatly mistaken there are fewer termites in and near New York City than there were more than 30 years ago when I first moved here. One very good reason for this is the sort of thing that happened in the "Presbyterian Hole" when it became a sunken garden. The present owner does not permit pieces of wood to lie on the ground and there are no stumps on his property. The same thing has been happening all through this region.

Any house is entirely safe from this or any other of our ground-nesting termites unless the woodwork of the house enters or comes near the ground. (Steps are often offenders.) Of course, if you make of your house an artificial stump, termites may and probably sooner or later will make use of your thoughtless kindness to them.

Even if your house is not correctly built and termites do get in, the house is not doomed. I have been told that Washington's home at Mount Vernon has had termites in its timbers as long as anyone now living knows. If that be true, they quite possibly moved in shortly after Washington did. In my boyhood days in Pennsylvania it was the usual thing for the country houses and barns to have termites in the timbers. Not knowing that the trouble was due to the wood touching the ground, the people merely from time to time replaced the affected pieces with new ones and, not being bamboozled by purposeful exaggerations of scare-mongers, they took their time about doing it.

Such being the facts, there is no need to discuss here any further the methods of prevention or cure. Some of the methods used by some "exterminators" are absolutely worthless or even worse; and some of the "exterminators" do not know termites when they see them, as is witnessed by the variety of insects that they have thought were termites when they weren't. Unfortunately, also, not even all entomologists who do know a termite when they see it are above sharp business practices. As for "guarantees," anyone who can get a sufficient number of good houses to insure against termite damage at even small premiums could get rich by doing nothing more, because the chances are that most of the houses will never become infested and that the few that do will not be seriously damaged.

In this, as in all other insect-control problems concerning which you are in doubt, write to your State Entomologist and to the Bureau of Entomology of the U. S. Department of Agriculture. Your taxes pay for their services whether you make use of them or not; presumably they know their job; and their advice is not likely to be tinged with ulterior motives. All of this is not to say that there are not many intelligent men, good entomologists, some working as "exterminators," making an honest living by controlling insect pests for those people who do not know how or who do not care to take the trouble of doing it themselves. Also, it is not to say that some day one of the dry-wood termites from some other place may not find its way to your region. If it does, the official state and federal entomologists should be told about it very quickly. Quite probably it would not become permanently established here; but, if it does, there may then be real trouble.

Darwin quite properly pointed out the service that earthworms do in turning over the ground and getting humus into it. But there are thousands of kinds of ground-burrowing insects; and, furthermore, there are thousands of kinds of wood-boring insects that are largely instrumental in clearing away dead and dying trees that would otherwise so clog the forests that there could be no new growth.

It is interesting to note that termites are among those insects that Nature uses to clear away stumps and fallen timber. In doing this they are very beneficial to the earth. If Man, in building houses, puts lumber, which is nothing but dead wood, in or on the ground, the termites quite naturally are apt to start clearing away that dead wood, too. Man's wooden houses and even Man himself are things of the last few days or so as compared with the geologic history of termites. If Man keeps the wood of his houses in this region sufficiently high above the ground, our termites will not bother him.

From the Halls of Montezuma

. . . to the buried refuse of some nameless Indian people of antiquity, George C. Vaillant has explored the Valley of Mexico to chronicle sixteen centuries of its pre-Conquest civilization

By D. R. Barton

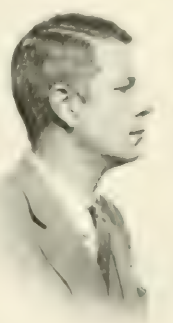
IN the [illegible] spring of 1919, an American army [illegible] occupied the Rhineland, Germany [illegible] the Versailles Treaty, and a [illegible] young freshman named George Vaillant flunked out of Harvard.

George had entered college the preceding fall on the not altogether unwarranted assumption that he would be taking [illegible] at the Hindenburg Line before the semester was out, and his plans were rather irritatingly upset when the whistles blew on November 11th. Fate, he felt, had played a cruel trick on him, and in the full recklessness of youth, he resolved to defy her without bounds or stint. Using Standish Hall as a base of operations, he neatly avoided both Widener and the recitation buildings to gad about Cambridge with all the lawless yearnings of an Andover matriculate who obviously belonged in New Haven.

The Vaillant family lived in a Victorian house on Commonwealth Avenue in Boston, an address at which George found it increasingly embarrassing to call after his demise at the hands of the faculty. However, Mr. Warren K. Moorehead of the Peabody Museum at Andover, an old friend of the family's, intervened on his behalf. Mr. Moorehead was hot on the trail of Indian arrowheads in Maine and he suggested to Vaillant Senior that such a robust outdoor quest might wean George from the oriental fleshpots of postwar Boston. Vaillant Senior agreed. And with the syncopated strains of "Dardanella" and "Titina" throbbing in his ears, George embarked, somewhat unwillingly, on the Peabody Museum-Andover Expedition.

Up to this time he had entertained the notion of majoring in English literature and retiring to a country seat (which included a prep school for boys) whereat he might support himself in dignified comfort and pen occasional, familiar essays on lost Keatsian odes or new developments in the interpretation of *Rasselas.*

It would be very pleasant and most convenient to record that Maine was young Vaillant's road to Damascus, that after coming up with a prize specimen his first day out, he was immediately smitten by the true light, and blinded to any other way of life save archaeology.



George C. Vaillant

In point of fact, he burrowed apathetically in a good many unrewarding graves, and his interesting finds were few and far between. He liked Maine, though, reveled in the out-of-doors, and came to the conclusion that desultory digging wasn't half bad once you got onto it.

This reaction was not altogether unexpected. For George had always held the Indians in high esteem and he had early begun to delve into the past as a hobby.

In spite of his laxity in regard to class attendance, George was a relatively accomplished historian and a fascinated student of military tactics. Moreover, his paramount ambition was to be a soldier, or rather, a lieutenant. Leading the A. E. F. at Belleau Wood? Afraid not. Vaillant's ambition was to be a lieutenant in the G. A. R., and he looked upon such upstart imbroglios as Chateau-Thierry and the Argonne with the rigid eye of a young Boston Brahmin reared in the shadow of Bunker Hill. For him the only worthy engagements were Antietam, Vicksburg, Cold Harbor, et al.

Apprenticeship

Early in the 'teens, George had fostered his antiquarian bent by stopping off at the Boston Athenaeum as he accompanied his father to work of a morning. Here he pored over not only the Civil War battles, but intimate correspondence dealing with the private lives of Civil War generals. This scholarly curiosity had been whetted by a widowed aunt who had survived an army officer stationed in the Indian Reservation region of the West where most of George's hero-generals served after Appomattox.

Hunting for arrowheads seemed to rekindle his boyhood admiration, and when he had finally completed his requirements for sophomore year by way of Harvard Summer School, he began to take up courses in anthropology.

From this time forth, Vaillant's academic career gave evidence of a marked change in his life. Despite the rigors of an at long last successful campaign of attrition against elementary German, he managed to be graduated and eventually to establish himself as a Winslow Scholar, from which austere vantage point he shortly became Harvard's first and, to quote him, "worst" tutor in anthropology.

Yet with increasing fervor, he had been absorbing the instruction offered on the technique and development of archaeological research, and he soon joined a select group in Harvard's Graduate School.

This was in the middle '20's, when stocks were booming and esoteric pursuits such as a sober and relatively unlucrative career in anthropology were tolerated with amused disdain. Then all at once archaeology sprouted romantic wings with the excavation of Tutankhamen's tomb, and the erstwhile gay blade of Harvard '22 found himself in Egypt with America's leading European archaeologist, George Andrew Reisner.

But there was a great deal of academic intrigue in the Egyptian air. And, repeatedly gored by the wiliness of his colleagues on the one hand and the Arabs on the other, young Vaillant decided to leave the mysterious East to the amazing fictions of his radiant contemporary, Rudolf Valentino, and to concentrate on the happier hunting grounds of the American Southwest.

It was here that he had cut his teeth, so to speak, and it was because of the excellence of his results in this region that the Carnegie Institution expressed interest in financing work to be done on the Middle Cultures of the Valley of Mexico,—a task which would throw light on the origin of the Aztecs, who are generally recognized to have reached the highest level of civilization in the pre-Columbian Americas.

At Harvard, George met Clarence Hay, Museum Trustee and a leading Mexican archaeologist in his own right. While working for Carnegie at Chichen Itza in Yucatan, Vaillant renewed this friendship. Hay was so impressed by the young man's handling of the excavations that he promptly engaged him as Assistant Curator of Mexican Archaeology for the American Museum, offering him a blank check to cover whatever digging he deemed important to the discovery of significant material on the forerunners of the Aztecs. Thus in less than the span of a decade, the scapegrace freshman flunk had expunged the unpromising start from his record and taken rank as a leading expert in his field.

Middle cultures

It is probable that a Mexican archaeologist is more certain of large renown if he devotes his efforts to the great centers of civilization which offer a better chance of spectacular finds. On the other hand, the Middle Cultures which Vaillant has made his particular province are of more importance to the science as a whole, since they formed the soil wherein the elaborate city-states came to flower.

The term, "Middle Cultures," was coined by Vaillant to signify their relativity,—"middle" referring to stage of cultural development, not geographical or historical location. He has further defined them as Lower and Upper Middle after the manner of the intermediate classes in many preparatory schools. In fact, Mexico's archaeological structure may conveniently be visualized as the student body of such a school,—the most advanced and powerful being seniors (e.g., Aztecs and classical Toltecs). Immediately beneath them in order of cultural attainment are the Upper Middlers, followed by the Lower Middlers, with the freshmen occupying the lower berth. Except for the latter—nomad hunters of the type that "forded" the Bering Straits untold centuries before —members of all these classes existed side by side as contemporaries in pre-Conquest Mexico. The original freshmen had taken up a sedentary life in Mexico's fertile valley long before they evolved the earliest pottery to be revealed by the archaeologist's spade. Nevertheless rough and tumble hunting peoples were constantly coming down from the north even as late as Aztec times.

Cannibals

Doctor Vaillant avers that he could not fashion a piece of pottery if his life depended on it. Yet he knows every step in the manufacture of most pre-Columbian Mexican varieties and he is as penetrating a student of their design as any in the world today. He can tell at a glance whether he is confronted by champ-levé or intaglio or merely simple incision. And a good thing he can, since pottery, together with figurines, comprises the sine qua non of his profession. For, whereas a study of the Aztecs, owing to the existence of various manuscripts, is inevitably part history and part archaeology, an investigation of the Middle Groups is archaeology pure and unalloyed. There is nothing to go on but the material. And the material consists largely of broken cook pots tossed into the garbage heap which was located just outside the front door of squat adobe houses. Truly, had departments of sanitation operated in those far-off times, there would be no archaeology today.

From the paltry evidence of this buried rubbish alone, Vaillant has been able to place under survey eight long centuries of Middle Culture groups. Extremely sensitive to differences in style and technique, he has separated his material into proper sequences of relative antiquity and ascertained whether it was used for household or ceremonial purposes. But how, you may ask, can a man pretend to tell anything about a people by just pawing around in their left-over junk? Well, some of the things are quite revealing.

"Once," he writes, "my wife found a great red-and-yellow bowl in such a deposit. It contained the remnants of the *pièce de résistance,* the upper legs and hips of a human being, the most succulent portions for festive consumption."

Here is an obvious case of ceremonial cannibalism. And the bones of the dead themselves, unearthed from the dump heaps, give a very clear idea of the physical appearance of the people under investigation, while their ideas of heaven are frequently suggested by the articles buried with them.

"A meager listing of objects found in the earth constitutes the historical record of the Upper Middle Cultures," writes Doctor Vaillant, "but by contrasting these pots and tools with those of the preceding era social forces may be seen at work. At Ticoman, the most carefully studied village site, the population terraced their rocky peninsula to make level places for houses which were too perishable to leave traces for later archaeological reconstruction. In the refuse beds deer bones are less in evidence than in the adjacent sites of the preceding period, indicating that game was gradually being hunted off. The Ticomanos made a greater variety of stone tools, both in shape and in purpose, and they found that the flakes of obsidian could be more easily worked than the more solid fragments used in Lower Middle times. Yet as techniques became more complex, the capabilities of the individuals differed. We found two graves of leatherworkers who were buried with the tools of their trade; one carefully fashioned his implements, while the other contented himself with chips and flakes, as if he cared more about finishing the job than taking pride in sheer workmanship."

These words indicate not only Vaillant's powers of observation but his keen appreciation of artistic integrity. His ready sympathy for the nameless artists of the long by-gone Lower Middle Group shows plainly in the following:

"In our modern world we are accustomed to sophisticated and self-conscious art forms. Seen objectively, these Early Middle Culture figurines are dumpy and gross. Short, fat bodies, blobby noses, protuberant eyes and stubby arms and legs are not attributes of a graceful form, according to our way of thinking. Yet handling one of these figurines and tracing each step in [illegible] tasy behind the meager scribbling of a child. Behind these figurines must have [illegible] complex rhythms of birth, growth and death in nature, epitomized in the miracle of woman and her bearing of children."

Origins and Calendars

With so reverent an interest in his work, it is not surprising that George Vaillant has been acknowledged a past [illegible] and interpreting his material. The curious thing is, he [illegible] "find." Indeed as far as archaeological "ten-strikes" are concerned, Mrs. Vaillant easily outstrips her distinguished spouse, her most sensational accomplishment being the discovery of some hollow clay figurines at Gualupita which linked this culture to that of Vera Cruz. And together the Vaillants discovered the astonishing hoard of [illegible] specimens at a single site. Yet Mrs. Vaillant professes no personal interest in archaeology. One wonders if she practiced it [illegible] so as not to be left behind. But Doctor Vaillant assures us that "her activities are prompted by a highly eleemosynary attitude, and I may say that she is very helpful, in fact so competent that after marriage I have not had to do any work at all."

It is a matter of record, however, that Vaillant has made ten trips into the Middle Culture digging areas and has written scores of papers about them. The achievement that has won him the loudest plaudits in scientific circles is the extremely ticklish task of bringing the archaeological study of some Middle as well as all "senior" cultures into the realm of history. That is, to establish the sequence of events and, if possible, the dates at which a given people passed from one cultural stage to another. This is a very considerable feat since the calendric systems of the Mexican Indians, while intrinsically admirable, are most difficult to translate into Christian historical terms.

Some idea of the complexity of the situation may be gained by a brief glance at Aztec dating methods. The major time unit has been estimated at 52 years. The end of this epoch was celebrated as a sort of mammoth New Year's Eve festival. An entirely new [illegible] festival gave rise to one particular custom which surely the gods must have ordained with archaeologists in mind. Symbolical of a new lease on life, the Aztecs set in motion a vast creative process by which all their artifacts were made anew, the community already having discarded all existing vases, urns, and general utensils whether in household or temple. In this manner future students were supplied with a made-to-order stratum denoting a specific 52-year period of artistic endeavor.

But there was a catch. Precisely because the beginning of a new cycle of 52 years was regarded as a renascence, no one cared very much about the old cycle. It was suspended in time—more or less merging with all its predecessors. For the Aztecs had no birth of Christ from which to number their major time units as we do our centuries. "In consequence there is the same sort of confusion in referring to events as would result were we to designate . . . the discovery of America . . . as 92 and the Declaration of Independence as '76."

Such are the difficulties confronting an archaeologist who has the temerity to attempt to correlate prehistoric cultures with historic time. And there were other snags. For instance, a lava flow called the Pedregal became a sort of New World Pompeii when a local Vesuvius suddenly put an end to its occupants and all their works. At what time did the eruption take place? "On the answer to that question hinges the date of these Middle Cultures, first traces of man in Mexico." Geologists estimated two to ten thousand years ago, which didn't help much. So it was up to archaeology to solve the problem if it could.

"First the materials from Copilco and Cuicuilco, the two buried sites [under the Pedregal], were compared and found to be different. Then these styles were discovered in other parts of the valley in open sites, unaffected by the local eruptions which formed the Pedregal. Next several seasons of work in these open sites disclosed that not only was Copilco older than Cuicuilco but that Copilco-Zacatenco culture was represented by rubbish heaps twice as deep as those at Cuicuilco-Ticoman. There is no way to measure the rate of accumulation of such heaps. However, on the basis of a deposit at Pecos, New Mexico, the beginning [illegible] dates of which are more or less known, it does not seem unreasonable to compute six or seven centuries' duration for the Lower Middle Culture of Copilco-Zacatenco and three hundred years or so for the life span of the Upper Middle Culture of Cuicuilco-Ticoman."

Oddities

In the course of reconstructing the life of these Indians of Mexico, Doctor Vaillant has come upon a variety of illuminating details, some of which may well bear repetition here.

The fate of the mighty city-state of Teotihuacan, by way of example, holds a warning for our own United States. The use of charcoal to burn lime by the builders of its massive edifices appears to have necessitated an unrelenting deforestation of the surrounding hills. Crop failures and a spreading "dust bowl" eventually resulted, all of which destroyed the economic basis of their civilization.

On the lighter side, we read that the Aztec bride, like our own, was customarily carried over the threshold of her new home—not, however, by the groom. One of the matchmakers fulfilled this ceremonial function.

The Aztecs stood very much on ceremony and it is revealing to learn that their arrow or dart points were no better examples of workmanship than the same utilitarian weapons found in the Middle Culture excavations. But the demands of their heavily ceremonialized religion brought about the fashioning of a broad-bladed flint "that could tear through human flesh at a single stroke, and this type of knife, not found in earlier horizons, was produced commonly with the extra care in chipping which is expected of a ceremonial object." It is in fact an almost ironclad archaeological rule that the cream of craftsmanship of any locality is to be found in the temple. And this rule does not apply to Mexico alone. It seems to operate in any community where the religion is conceived as absolutely essential to group survival.

The hideous brutality of the human sacrificial rites among the Aztecs is too well known to need underscoring here. And it chills us to the marrow to think of the loving artistry expended on the lavishly decorated lava boxes in which human hearts were burned and stored. But we must remember that the cult of human sacrifice is world-wide and that the Crucifixion paintings and statuary which form the bulk of our own Western religious art are all commemorative of the Savior's martyrdom, which is the highest point of development in the history of human sacrifice. The concept that the supreme sacrifice of Christ effected the salvation of countless generations as yet unborn—though it has become familiar enough to us who emphasize the priceless value of the individual—would be quite incomprehensible to the Aztec. Life seemed to him to exist from day to day only by divine sufferance. And "from boyhood on, [he] spent much of his time either in a kind of beseeching penance, to ensure his future, or in a state of grateful atonement for not having had a worst past. The Aztecs lived on intimate but uncomfortable terms with the supernatural powers." They practiced cruel mortifications of the flesh as a matter of course. And, brought up to regard the daily sight of blood and violent death as proper, they were not so much hardened as lacking in the sympathetic "imagination which is too personal and egocentric a sensation for an Indian community."

No, the Aztec was anything but an egoist. He belonged. His personality was swallowed up in the tribe. And it was tribe survival and tribe salvation that his culture stressed at the expense of all other considerations. To us this seems totalitarian and barbarous. And certainly the religion was both. In fact so tyrannous and rigid, so smothered in group-saving ceremony did it become that ultimately it destroyed the civilization itself. In the pragmatic sense, it was no match for a religion like our own which is marvelously "adjusted to meet such totally different concepts as the demands of the powerful and the needs of the weak." Doctor Vaillant points out further that our "Western civilization on the social side is nothing to boast of today, so we need not be scornful of the Aztecs [who] would have been horrified at the naked isolation of an individual's life in our world."

All the observations quoted above are from Doctor Vaillant's recently published *Aztecs of Mexico,* the second volume of Doubleday, Doran's "American Museum of Natural History Science Series." In this book he has summed up the history of the Valley of Mexico from the first spadeful of Lower Middle Culture objects to thumbnail sketches of the socially conscious peon of today. Though his sym-

Continued on page 126

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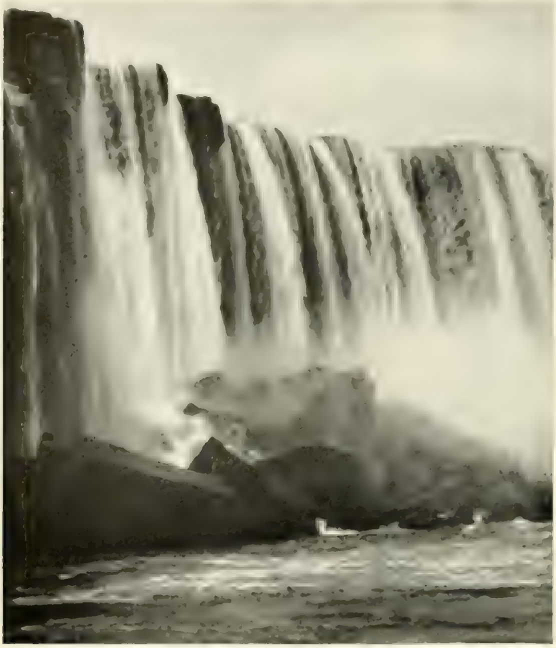

Charles H. Coles

Terrapin Point from the *Maid of the Mist*

By CHARLES H. COLES

[illegible]
American Museum of Natural History

A PHYSICIAN-PHOTOGRAPHER once remarked that water possesses a strange fascination for us because we subconsciously recognize it as the medium in which we originally lived aeons ago. Whether this is so or not, some of the most interesting and appealing subjects for the artist as well as the photographer are those in which water plays an important part. Ponds, streams, rivers, rain, ocean waves, and waterfalls are pictorial subjects that [illegible] geology, meteorology, and aquatic wildlife.

A waterfall is, perhaps, as appealing and majestic a subject for either the still or movie photographer as may be found, but there are many waterfalls and many ways to photograph each one. Several fundamental principles remain, however, to guide the photographer in making the most of his picture opportunities whenever his travels bring him to these tumbling rivers of water.

Don't freeze water in action

Perhaps the first phase of technique to discuss is the matter of what shutter speed to use in photographing a waterfall. The first reaction of a camera fan is to treat the falling water as a moving subject whose motion must be stopped by a high shutter speed to prevent blurring. Actually, we never see each droplet of water suspended motionless in mid-air. If a photograph were to show the water sharply, its motion arrested by the shutter, an unnatural appearance of being frozen would result.

Experience has shown that a shutter speed of 1/50th of a second gives a very pleasing picture. The slightly blurred appearance of the water will convey the feeling of motion that a photograph of a waterfall should possess.

Sunshine on the water enhances the brilliance of the photograph to no small extent. If the picture is made when the sun slants on the falls at a glancing angle, the solidity of the water and the contours of the falling sheet of liquid will stand out in bold relief and give a third-dimensional aspect that is a delight to see.

Since the brightest part of a picture always captures the attention of the spectator first, it follows that the most important part of the picture should be lighter than the rest of it. A medium yellow filter will darken the sky above the waterfall without affecting the brightness of the falls; thus the water will become the brightest part of the picture and the composition of the photograph greatly improved.

Camera position important

To produce the effect of grandeur in a picture of a waterfall, you must emphasize the height of the falls. A low point of vantage will usually accomplish this end. If it is impossible to get far enough away so that the camera does not have to be tilted up sharply, a position opposite the center of the falls will permit the camera to be held level. A tilted camera should be avoided, so that the falls will not appear to lean backward.

The position of the camera should be chosen with due regard to the wind direction, because the mist thrown up at the base of the falls can completely obscure the waterfall itself if carried toward the camera. The water will also deposit upon the lens and blur the photograph besides entering the shutter and possibly ruining it. A stiff cross-wind will clear the mist away and reveal the beauty of the falling water to best advantage.

That mecca for tourists and honeymooners, Niagara Falls, presents many intriguing problems. The Canadian side offers the best comprehensive view of the American Falls, particularly at night, when multicolored lights are projected upon the foaming water. Although it seems presumptious to improve upon nature, there are those who are not satisfied unless they gild the lily, and the great number of Kodachromes taken of this color illumination on the falls testifies that the display pleases a great many. The time exposure required to make a picture at night, however, reduces the water to a feathery, blurred mass that resembles ice much more than water.

Because of the protected area around the large electrical generating stations located on the Canadian side of the gorge, it is now impossible to obtain anything but a long-distance view of Horseshoe Falls, quite unsatisfactory for photography.

The Cave of the Winds trip on the American side, while very exciting and unusual, is decidedly not a photographic excursion unless the photographer is equipped with an undersea camera. No doubt some interesting shots could be made but they would be of the party rather than of the falls themselves. If you want pictures such as these, purchase a cheap box camera and use this rather than an expensive outfit. If the box is ruined by water entering the shutter, the loss will not be serious. A motion picture of the party passing through the spray would be very amusing, but the problem of keeping the lenses and mechanism dry is difficult indeed.

The *Maid of the Mist* offers some excellent views of the falls, when the wind direction is such as to keep the spray away from the vantage points on the trip. A good idea is to stay on the lower deck alongside the cabin entrance. When the spray becomes too dense to be good for the camera, step into the cabin until the storm blows over. An exceptionally fine picture can be made when the *Maid of the Mist* is off Terrapin Point: the falling water and cliff form an impressive scene.

Undoubtedly the most effective picture showing the height of the falls can be made from the lower station of the elevator that takes the passengers down to the *Maid of the Mist.* Although only a small portion of the American Falls can be seen from this position, the possibility of including human figures to give scale to the towering wall of water makes this view the most impressive obtainable at Niagara.

As with Niagara, the best camera view of the great falls of the Yellowstone is to be had from the bottom. Uncle Tom's Trail is taken down into the canyon to this point, where the whole majestic height of this magnificent falls towers far above the billowing spray. Morning light produces by far the most effective pictures of the Yellowstone Falls, since this is the only time of the day that the sun shines on the water.

To capture the size, the majesty, the beauty of a waterfall in an enlarged photograph is to obtain a picture that cannot be surpassed in decorative effect upon any wall.

When hunting bear—

IT'S wise to be well-equipped. And when hunting with a camera it's a *must* to be well-equipped! Many, many naturalist-photographers choose Agfa Film. It is the only film with the guarantee: "Pictures that satisfy or a new roll free!"

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THE TRUTH ABOUT LEIF ERICSSON AND THE GREENLAND VOYAGES TO NEW ENGLAND

by William B. Goodwin

Meador Press, $[illegible]

ACCORDING to this rather fascinating book [illegible] the discovery of America now generally credited to the early Norse settlers of Greenland may have to be credited to the Irish! The author is one of many who during the past one hundred years have studied the old Icelandic Sagas, and the results of his 30 years of labor deserve the extended consideration of some John Fiske rather than the brief superficial comments here possible.

The chief problem involved in the elucidation of the five or six recorded Norse visits to our shores between the years 1000 and 1020 A.D., is the identification of their so-called "Vinland" and in particular the situation of Leif Ericsson's houses at "Streamfiord," as well as the locality explored by Thorfinn Karlsefne and by him called "Hop." Earlier students of the sagas have located these places at various points, ranging all the way from the Gulf of St. Lawrence to Newfoundland, Nova Scotia, and New England down to the mouth of the Hudson River. Mr. Goodwin has himself seized upon Portsmouth Harbor, New Hampshire, as "Streamfiord" and Plymouth Bay, Massachusetts, as "Hop"; and seemingly he gives good reasons for his choices. One of his reasons for believing that the Irish preceded the Norsemen to the same general region is his discovery (as announced in the press some two or three years ago) in adjacent parts of New Hampshire and Massachusetts of a number of apparently ancient architectural stone structures which are too far inland to be regarded as the abodes of the Greenland visitors. But however these finds may turn out, the author lists and partly illustrates some twelve or more stones, as well as two steel axes, all of which bear what appear to be runic inscriptions and which have been found all the way from Greenland and Baffin Land down to Massachusetts.

Another important topic dealt with is the strange geographical term "Norumbega"—well known in archaeological literature [illegible] old maps from about 1525 and onward [illegible] that interval the word is spelled in many different ways and some of its forms—Noruegia, Noroega, Norbegia, Norvegia, etc.,—appear also on the Scandinavian peninsula. This phantom realm in America is placed at various points from the Hudson valley northeastward and was eagerly sought after by the early French and English explorers. Mr. Goodwin believes this proves that Columbus and others of his day had knowledge of a still-lingering tradition of the old Norse settlement in the Western world and that "Norumbega" and "Vinland" were one and the same region.

The organization of Mr. Goodwin's material leaves something to be desired, and while this phase of Norse colonization over here is of little historical importance because it didn't stick, there must be many readers who will find the book interesting.

N. C. N.

CHILE: LAND OF PROGRESS

by Earl Parker Hanson

Reynal & Hitchcock, $[illegible]

MR. HANSON knows whereof he writes. Several years' experience as a mining engineer and in other connections in Chile has given him firsthand knowledge of that country, its people, and their problems, and he handles his material in an informing and convincing manner.

In the opening chapter, "The Land," we are given a survey of Chile's geography, her resources, and climate. Though we realize the extent of his field and the limits of his space, we nevertheless wish that the author had more strongly emphasized the part that a temperate climate has played in the origin and development of Chile's population. To this climate she owes the Araucanian Indian, one of the finest indigenes of the New World. To this climate she is also indebted for the large representation of North Temperate Zone races within her boundaries, as well as for the practical absence from them of a tropical element. Chile's melting pot has barely begun to simmer, but the possibilities offered by fusion of its contents should promise the Chilean of the future a high place among the world's peoples.

Succeeding chapters are entitled "History," "People and Government," "Culture," "Agriculture — Fishing — Lumbering," "Mining and Manufacturing," "Education," "Social Legislation," and "Chile and the Visitor." To the last we would add a warning to the tourist to visit the lake region in the less wet period between late December and early February.

No one reading Mr. Hanson's impressive analysis of the factors which are now so actively shaping Chile's future will doubt that it is indeed a "land of progress"; but whither, one asks, is the nation progressing? Chile's position, her products, her population, her potentialities make the answer to this question of supreme importance to the entire Western Hemisphere.

I. M. CHAPMAN

MUMBO JUMBO, ESQUIRE

by James Saxon Childers

D. Appleton-Century, $5.00

DURING a long journey through southern, eastern, and central Africa, then down the Nile and westward to Morocco, Mr. Childers was struck by two contrasting aspects. Over the old primitive Africa has been flung a network of up-to-date civilization. He gives an excellent account of the modern cities, the latest modes of travel and communication, the life of Cecil Rhodes, and the story of diamonds and gold.

A Hindu religious ceremony in Natal, the changing life of the Zulus, and a visit to the Kruger Park are splendidly treated. The ways of natives in the equatorial regions are not so well appreciated. The Ituri pygmies are dismissed as filthy little people living mainly from the tourist trade, but he must have seen them only along some main road.

Mumbo Jumbo, for whom the book is titled, was a tribal disciplinarian in Senegal who kept the pagan women in subjection. No one like him appears in this book. Mr. Childers paints a lurid picture of tropical diseases, and fears the sun overmuch.

Photographing big game he preferred to slaying it. His own stories of the creatures are thrilling, but those he borrowed from others are less reliable. Certainly more than three African elephants have been brought alive to the United States. The eating of prisoners by Congo soldiers is just another of the wild stories to be heard in East Africa about the Belgian Colony.

We are continually reminded that the author is an American, and was recognized as such. Sometimes it exasperates him, sometimes he is charmed, as on the American steamer bound for Zanzibar. On the trip down the Nile, the old and the new Africa are again at odds. The trials of a tourist in Egypt are told with brutal frankness, though ancient glories are not forgotten. The illustrations of the whole book are beautiful and well-chosen.

JAMES P. CHAPIN.

ASSAM ADVENTURE

- - - - - - - by F. Kingdon Ward

Jonathan Cape, London, 12/6

THIS is the ninth book on plant hunting by a man who has had great experience in this field. The basis for the present volume is a trip made across the Assam Himalayas in 1935, and supplemented by a later visit to these mountains in 1938. Part of the travel was in regions perhaps never before visited by a white man, certainly never studied by a botanist. The author's interest is primarily in plants, but he makes extended observations on topography and on the natives.

The book will make its greatest appeal, among the lay public, to those who love plants. The temperate to alpine zones of Tibet produce a flora of great significance to Americans. Many important groups of plants are common to both places, and some of the fine ornamentals, brought from Asia to the United States, have become so familiar that we can consider them naturalized citizens.

But what a privilege it is to see these plants growing in their native environment often, as in the case of primroses, in great breath-taking masses! To one who has struggled to rear a few rhododendrons through the vicissitudes of our eastern climate, the forests of the tree forms of that plant in Assam and Tibet or the thickets of the shrubby or dwarf species seem well-nigh unbelievable. But the climate encountered by the author in Assam has its vicissitudes as well, and his travels there prove him to be a hardy explorer.

One must read *Assam Adventure* slowly, because it requires time for digestion. The place names do not memorize easily, and it is difficult to keep oriented.

The illustrations, taken by the author, are very good and are helpful in visualizing ideas expressed in the text. The map is also an aid, and should be well studied in advance.

H. E. ANTHONY.

THE FLOWER FAMILY ALBUM

- - - - by Helen F. Fischer and Gretchen Harshbarger

The University of Minnesota Press, $2.50

TWO novel features make this outstanding among recent flower books. The plants are drawn to scale as seen in the garden, and both wild and cultivated members of each family are represented. Some 450 plants are illustrated in the line drawings which are arranged according to plant families. Opposite each page of illustration is an interesting discussion of the family and its representatives, combining folklore with gardening recommendations and unusual facts.

In many cases, drawing the plants to scale has required the addition of larger drawings of the blossoms above the plants. More of these detailed sketches and a more complete statement of the botanical characters which aid in the identification of each family would have made this book more useful to the advanced flower lover. The amateur gardener and the nature study teacher, however, will find this book a fascinating and attractive introduction to the plant families and their more familiar members in woods, fields, and our flower and vegetable gardens.

J. W. THOMSON, JR.

THE BLOOD OF THE ARAB

- - - - - - - by Albert W. Harris

The Arabian Horse Club of America, $5.00

IN this most entertaining book, charmingly written, the author shows the result of much diligent research regarding the early history, and origin so far as can be stated, of the finest of horses, the Arabs. He gives many proofs of the superior intelligence and courage and the remarkable endurance of this breed, or rather distinct species as he rightly considers it.

The author gives detailed accounts of long-distance endurance tests of several hundred miles in which horses of many types competed under the saddle. In these grilling contests the Arabs proved themselves to be unquestionably superior.

It is with much satisfaction that the writer notes the increase in America of this splendid type of horse. In 1913 there were 27 owners of 127 horses while a recent report shows 402 owners of 1335 horses.

He tells of his experience on a cattle ranch in Minnesota, when only a boy. Here he made the acquaintance of a beautiful little black stallion, "Jim," which he rode about the ranch. A real friendship developed between "Jim" and his rider. While at the time the boy did not realize it, "Jim" carried in his veins a high percentage of Arabian blood. It may well be that this chance incident was largely responsible for the later development of an absorbing interest in Arabian horses and finally the appearance of the book under consideration. The writer speaks interestingly not only of Arabian horses but of those interested in the subject, many of whom I have had the pleasure of knowing. One of the charms of the book is the fact that the author, quite unwittingly, reveals much of his pleasing and generous spirit.

An anatomical detail might be criticized. On page 118 the author seems to have slightly dislocated his horse's kneecap, or patella as the anatomist terms it, which like our own is on the hind leg. But possibly this point should not even be referred to as nearly every horseman will speak, though quite incorrectly, of the carpus, or wrist joint in the horse's fore limb, as the "knee."

The book, well illustrated with more than 70 beautiful pictures, is a valuable contribution to equine literature, and is also interesting to the layman.

S. HARMSTED CHUBB.

LUCK IN ALL WEATHERS

- - - by Donal Hamilton Haines

Farrar and Rinehart, $2.50

THE character of this book is well expressed by its subtitle, "Personal Adventures in Hunting and Fishing." To the reviewer the most interesting and informing of these adventures is not the author's account of his pursuit of birds and fish (chiefly ducks, trout, and bass) but his introspective revelation of himself as a sportsman. To us he represents the best, most highly developed type of modern hunter. His ethical standards are high, he would not permit himself to take unfair advantage of his game. He shows generous consideration for the rights of his fellows in the field as well as those of the owner of the land on which he hunts. He supports the game laws both in preaching and in practice. His equipment and technique are the outcome of prolonged, constant observation. Indeed the major part of his pleasure afield is found in the employment of methods that he has originated, and in the success to which applied experience enables him to outwit his prey. He shows little or no interest in the gustatorial end of his pursuit, and is obviously not dependent for food on the contents of his bag or creel.

In short, he has apparently reached the height of modern man's evolution from the primitive hunter. But sweep aside Mr. Haines' acquired characteristics, material, technical, mental and we find that the bond between him and his Stone Age ancestor is as strong as though their birthdays were separated only by hours instead of countless generations. Nowhere do we find in his very readable volume any evidence that from his life as a hunter has grown a love of the homes of the hunted.

F. M. CHAPMAN.

NEW WORLDS IN SCIENCE

- - - - - - Edited by Harold Ward

Robert M. McBride and Co.

THIS large, well-made book is an anthology of recent nontechnical articles on science by 33 contemporary American and British scientists. The advantages of anthology are successfully exemplified: each subject is treated by a writer who has special and thorough knowledge of it; different points of view are persuasively presented; varying personalities and styles give color and maintain interest. There are also disadvantages: chapters removed from context may lack background; quality is likely to be uneven; continuity may be lacking. Here the editor has skillfully performed his difficult task.

[illegible] all the variety of the separate passages: the design of human life, the conquest of energy for social use.

The anthology will be profitably read for its information, but it has another, more subtle value. It reveals not only what scientists are doing, but what they are thinking and the direction of their personal orientation in society and in the universe. No objective review of a field of [illegible] and, to this reviewer, it is the unique virtue of this particular compilation.

This book is fascinating and exciting. [illegible] it should be owned and read by scientist and layman alike.

[illegible]

AMOS EATON: SCIENTIST AND EDUCATOR

by Ethel M. McAllister

University of Pennsylvania Press, [illegible]

AMOS EATON, who has been called the "greatest popularizer of natural science that America has ever known," was much more than that. Teacher, founder of Rensselaer Polytechnic Institute, and an authority in numerous fields of science, he was a leader in that group of naturalists who laid the foundations for all that has been accomplished in American natural history in the past century.

Author of textbooks, manuals, and "dictionaries" in botany, mineralogy, geology, zoology, chemistry, physics, and mathematics, Eaton considered himself above all a geologist. And it is in this science that he had his greatest influence on the scientific thought of this country. He has been called "the founder of the American system of geology," and the decade 1820-[illegible] has been designated as the Eatonian Era by Merrill. As a teacher at the Rensselaer School Eaton was able to say, about one month before his death in 1842, that "more than half the State Geologists of the Union" had been his students. Without doubt the most famous of these was James Hall; but the names of Ebenezer Emmons, George H. Cook, Douglas Houghton, and Benjamin F. Greene, to mention only a few, are fitting monuments to his influence as a teacher and scientist in the progress of geology in this country.

When one considers that, in addition to great accomplishments as a scientist and teacher, Eaton led a full family and early business life, and spent four years in prison on a charge of forgery, it becomes obvious that Miss McAllister has had a [illegible] base this work. The fact that much of the information here contained has been derived from the correspondence of Amos Eaton and his close friend, John Torrey, should add to the appeal that this great [illegible]

H. E. Vokes.

INDIAN AGENTS OF THE OLD FRONTIER

by Flora Warren Seymour

Appleton-Century, $3.50

ALL readers of nonfiction books on Indians will be interested in this new volume. It begins with brief sketches of such original Indian agents as Sir William Johnson of Iroquois fame, William Clark who had initial charge of all the Indians in the territory known as the Louisiana Purchase, the learned and capable Henry Schoolcraft, and, not to overlook one of the most picturesque agents, Kit Carson. A number of forgotten names will be found duly annotated in this preliminary list. Among later famous agents are the 22-year-old John P. Clum, who controlled the fierce Apaches without support of the army, the fearless James H. Wilbur of the Oregon country, known among Indians as Father Wilbur, the conscientious patient Quaker agents, Laurie Tatum and John Miles, the rugged individualists, James McLaughlin and T. V. McGillicuddy, the wonderful Colonel Pratt, and the distinguished General Scott.

Many of the agents mentioned had real adventures, the reciting of which will increase your respect for the inherent bravery of mankind. The sketches of these agents are arranged in chronological order and so give an historical outline of Indian policy. As the author sees these events in perspective, the hopes of Colonel Pratt and others that the Indians would vanish in the American melting pot are not to be realized for centuries because the laws of the nation require that the lands and capital of the Indians be forever held in trust for the support of persons of Indian descent. So long as this policy endures we shall have books about Indian agents and their works.

Clark Wissler.

HOW MIRACLES ABOUND

by Bertha Stevens

John Day, $2.50

HERE is an excellent book for teachers and parents, planned to aid in stimulating interest in nature. Miss Stevens has also written other books of high merit along somewhat the same line, namely, *Child and Universe*, *Nature the Child Goes Forth* and [illegible] *Reporter of the Universe*. The last mentioned was reviewed in the November, 1939, issue of Natural History Magazine. The author is a practical teacher, and she has actually used the materials discussed in these books with her pupils. Her suggestions are so convincing that one cannot doubt that she has used them with marked success. With the great teacher, Pestalozzi, she does not believe in telling a child that which he can discover for himself.

It is evident that the author is unusually well-equipped as an all-round naturalist, and it is encouraging to the student of nature to have a book of this kind written by one who has so high regard for scientific accuracy. There is, however, a typographical error as to the number of constellations. The astronomers recognize and use more than twice 42 constellations.

For each of the ten chapters of this book Miss Stevens has selected a "miracle,"—a [illegible] a dewdrop, a lima bean, a petunia, a tree, a snail shell, a goldfish, and the hand. This is a varied list and well-chosen, but as every naturalist knows, and as suggested by the title of the book, the author might have prepared ten chapters on selections from myriads of other objects. The illustrations from line drawings and photographs add much to the interest and attractiveness of the volume.

Clyde Fisher.

THE MARVELS AND MYSTERIES OF SCIENCE

by Clyde Fisher, John [illegible]
James P. Poole, John A. Timm
Terrence T. Quirke, Clark Wissler

Wise, $2.95

THE *Marvels and Mysteries of Science* is a popular survey of five important fields of science, written in everyday language for Mr. John Q. Public. It is a one-volume encyclopedia designed to aid the man on the street in the mysteries of astronomy, geology, physics, biology and anthropology. Each of its five sections is either written or approved by recognized scientists in these various fields. While the story of science is simply told, it is accurate and surprisingly comprehensive.

Readers of Natural History Magazine should be particularly interested in this volume, since it contains the work of two of the leading Museum curators. Dr. Clyde Fisher, Curator-in-Chief of the Hayden Planetarium, wrote the Introduction and was responsible for the chapter on astronomy. Doctor Fisher's Introduction, while brief, is an excellent review of the development of science from the earliest days to the present.

The section on anthropology is the work of Dr. Clark Wissler, who is Curator of Anthropology at the American Museum. This section of the book contains four chapters which include "Human Paleontology," "Modern Peoples," "Ethnology and Archaeology," and "Cultural Anthropology." Those who are familiar with Doctor Wissler's numerous writings on these subjects know how eminently well qualified he is to handle them and we can vouch for the fact that he has done an excellent piece of work in these chapters.

The book is copiously illustrated and well indexed. We feel that it will make a valuable addition to any library where a one-volume work on science is desired.

Robert R. Coles.

THE LAST MILLION YEARS

- - - - - - - by A. P. Coleman

University of Toronto Press, $3.50

THE death of Dr. Coleman, two years ago, removed the Dean of North American glacial geologists. Within this relatively small volume, which was almost completed at the time of his death, and has been subsequently edited by Professor Kay of the University of Iowa, he had summed up the results of his lifelong study of the history and effects of the glaciation of the Pleistocene period.

The last million years of the earth's history is dominated by the spread of glaciers over the continents of the northern hemisphere. Dr. Coleman confines his discussion and description of this glaciation and its effects on the land and its life to the continent of North America. In his introduction he sums up the importance of this glaciation:

"The most populous parts of the United States and Canada were ice-covered in the Pleistocene and the work of glaciers has profoundly influenced the present life of the region. The soils, the scenery, the routes of roads, railroads and canals, the sites of cities, the Great Lakes and their connecting rivers, and even the international boundary between the two countries, were closely bound up with the advance and retreat of ice sheets in the geological period immediately before the present.

"No one can really understand the geography and the human history of the northern United States and southern Canada without a knowledge of the strange events that shaped things as they are and prepared the way for our present civilization."

It is not a popular book, as that term is generally used, but it is essentially a non-technical account designed to interest the intelligent general reader as well as to summarize for the geologist the present status of our knowledge of Pleistocene events. Above all, it is a significant summary of the lifework of a great scientist.

H. E. VOKES.

LIFE AND LIVING

- - - - - - by Frederic Wood Jones

Kegan Paul, Trench, Trubner
London, 10/6

THESE brilliantly written essays were originally delivered as lectures before academic audiences in Australia and Tasmania.

Professor Wood Jones, an experienced debater, immediately enters upon a discussion of the two opposite and controversial methods of approach to life and living, "Mechanism and Vitalism," and declares vigorously for vitalism: "There would seem to be good cause for believing that materialistic doctrines of pure mechanism have had their day in the interpretation of life and that we have witnessed their passing. It is likely that we are all on the threshold of a new phase of thought in everything relating to life and the essential nature of the living." As always, he makes his case good.

In a discussion of the biological implications of the mammalian toilet the author reveals the great wealth of his own observations made upon living animal subjects and especially the results of his long and close study of the primate hand.

In "The Changing Point of View" the author most clearly proclaims his faith as philosopher-anatomist: "Both the extremely little and the extremely large are so far beyond our comprehension that no human mind may see wholeness in it all; but an approach to wholeness may lie in an appreciation of the apparent underlying similarity of design that seems to stretch from the atom to the universe. . ." Here he quotes Francis Thompson: ". . thou canst not stir a flower Without troubling of a star." He continues: "No new physicist, no biologist, has so far given us a concept of organism so completely satisfying as this. . ."

The book is interesting throughout, showing the author's full grasp of the literature relating to biology and especially his own subject—anatomy. His original observations on the structures and habits of animals are almost innumerable and make a convincing background for his philosophical interpretations. I have only favorable comments to make on this work.

H. C. R.

A FIELD GUIDE TO WESTERN BIRDS

- - - - - - by Roger Tory Peterson

Houghton Mifflin, $2.75

MR. PETERSON'S *Field Guide to the Birds* has become indispensable to all field bird students in the eastern United States. In the present volume he places western bird students equally in his debt. The two combined cover the bird life of the Union and its coasts.

The "Peterson method," first introduced in 1934, is now too well known to require description. To say that it evidently has been made to work as well in the West as in the East is a tribute to its author's skill in meeting the requirements presented by a successful treatment of the somewhat more complicated problems presented by western bird life.

The author has supplemented his own experience by liberal use of pertinent published works, and has secured the cooperation of many other bird students both in the East and in the West, the sources of this assistance being fully acknowledged. In its surprisingly successful achievement of its main purpose Mr. Peterson's book deserves unqualified praise, but we continue cordially to disagree with his estimate of the value of the work his book is so well designed to promote. Admitting that a bird list in itself is not the highest type of scientific literature, bird lists in the aggregate form the foundation of faunal and seasonal ornithology and they thus become indispensable contributions to this phase of bird study. A bird census is not a profound document, but the combined Bird-Lore Christmas censuses of the past 40 years form a unique record of the midwinter bird life of the area covered, and as such this unequalled mass of data has exceptional scientific value in its special field.

There is, therefore, no reason for the "bird lister" to apologize for his occupation. True, it represents the kindergarten stage of the bird student's training, but it is an essential part of his education if he hopes to become a graduate ornithologist.

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[illegible] comings of our own culture and the magnificent artistic and architectural [illegible] engineering were completely unknown. [illegible] goddess, he says, "Her statue was never finished. It still lies anchored to its matrix of living rock and cannot fail to impress the modern visitor. Its concept is grandiose, but the engineering skill was lacking to cut the sculpture free of its base. Prometheus in his chains may symbolize the tragedy of European thought, but to me this goddess, still an integral part of the land that made her, represents the paralysis of Indian civilization."

We are fortunate indeed to have so sensitive a view of Indian history enclosed within the covers of a book. Even as the master playwright or novelist must identify himself with the thoughts and feelings of his characters, so must the anthropologist be capable of assuming the bias of the people under his investigation, of feeling himself a part of their ethos. Not only has Doctor Vaillant attained this special insight, but, perhaps more important, his own admirable prose evokes the attitude in the reader. "Today," he writes, "there are grubby railroad yards and slums where the Aztecs made their last sacrifice and bled to death. The ghosts of its heroic defenders still haunt the place."

Yet he bears a heartfelt affection for the living Mexico which is, as it were, his alma patria. And Mexico is not insensible of his scholarly devotion to its interests. Recently the National Museum of Anthropology appointed him as Honorary Professor—a select title shared with only four or five other scholars, and one for which he is deeply grateful.

[illegible]

There is another consideration which makes us doubly grateful for Doctor Vaillant's book, and one which we must confront with mixed emotions. For, this very month, he leaves the American Museum to undertake the Directorship of Pennsylvania's University Museum at Philadelphia, and for him a new and exalted life must [illegible] in truth, the other's loss. But there will be none to begrudge him the honor of such an impressive advance-[illegible]

Meanwhile he has left us a summary of his fourteen years of scholarly devotion to the Mexican Indian while on the Staff of this Museum. And there could be no leave-taking more appropriate to the times than the final paragraphs of that work which are hereby appended:

"The civilization of the Indian may not offer a direct inspiration to us modern individualists, yet we have profited from their labor in our food plants and the wealth produced by our neighbor republics to the south. In this world, torn with hate and war, adrift without an anchor or a compass with which to chart our course, we may well consider their example. The Indians worked together for their common good, and no sacrifice was too great for their corporate well-being. Man's strength lay in the physical and spiritual welfare of the tribe, and the individual was honored only inasmuch as he contributed to that communal good. The Indian civilization may have been powerless to resist the culture of the Western world, but it did not consume itself, as we are doing, in the expression of military power.

"The American countries today share the ideal of the republic and individual freedom. We share also an older tradition left us by our Indian forebears, that of mutual service for the benefit of man. With our continents spread before us, we have boundless opportunity to create on earth a wider life for everyone, an American civilization where old and new contributions to human welfare may be fused and amalgamated for the benefit of all."

DO NOT MISS

MONUMENT VALLEY in southeastern Utah and northeastern Arizona is one of the very few natural wonders still isolated from the main stream of tourist traffic. A magnificent story in photographs by Josef Muench will shortly bring its scenic grandeur into every NATURAL HISTORY reader's home. Mighty structures of stone rise 800 to 1200 feet from the valley floor, all miraculously carved by Nature into shapes of fantastic beauty.

•

The next time you aim your gun at a hawk or a coyote, a mountain lion or any other predacious animal, just remember that intelligent people consider predators occasionally harmful but usually beneficial. Don't miss **SHERMAN BAKER'S** answer to the question, "Why Pick on the Predators?" Learn about the dynamic relationship between the predators and the resources of any given area, how predators protect man from bubonic plague, and other startling points in a compelling defense of our native carnivores.

Continued from page 66

game fish, such as the large-mouthed bass, display the unquestioned ability to discriminate between colors.

Numerous species of tropical fish assume brilliant body colors at the time of spawning. Experiments conducted in the Laboratory of Experimental Biology at the American Museum of Natural History revealed that a female selects as her mate the most brilliantly colored male available. Baby jewel fish, whose parents are brilliant red, will swim toward any moving red object and avoid other colors.

The fact that fish will strike at spoons and spinners is, of course, no indication of color blindness. Mr. Hough's story of trout that ignored artificial flies and attempted to seize the fisherman's reel is a case in point. The small flies may not have been noticed by the trout; whereas a large metallic, shining reel would be more likely to compel the fish's attention. A whirling spinner drawn rapidly through the water displays more motion and reflects a greater amount of light than does a dry or wet fly. It is not surprising, therefore, that fish swimming several feet below the surface of the water are attracted by the metallic lure although they may fail to notice the flies. It is inaccurate to conclude that the fish is color-blind merely because it can be caught with devices that are not colored.

Mr. Hough's belief that the fish "has just sufficient brain power to open his mouth when he sees something to eat" does the fish an injustice. Students of animal behavior know that fish can learn to swim through complicated mazes without entering any blind alleys. Furthermore, they can learn to come to the surface for food in response to a number of visual stimuli. We must not overestimate the intelligence of fish, but they are not nearly as stupid as Mr. Hough would have us think, and the consistently successful angler can take credit for a working knowledge of one field of natural history.

* * *

SIRS:

. . . The binder I am ordering will preserve my seventh year of NATURAL HISTORY Magazine, which I trust will continue to be the same magnificent and highly instructive share of the American Museum which those of us far from New York City are privileged to enjoy.

ROBERT E. BALL.

Canton, Ohio.

* * *

SIRS:

Your museum probably does not have much upon the "nerve of a brass monkey," but we are afraid, by the time you have read this letter, you will know more of it.

Is there anyone who belongs to your association who would be glad to pass along his old copies of NATURAL HISTORY to our library?

We can't afford to take it, but it would be a useful reference tool for us, since it is indexed in the *Reader's Guide*.

We have just had a few copies given us, and are delighted with it. So, even though you may not find us "an angel" to give us his back numbers, we still sit here in Pottsville and sign ourselves,

Admiringly yours,

EDITH PATTERSON,
Librarian.

Pottsville Free Public Library,
Pottsville, Pa.

* * *

SIRS:

For a long time I have been wanting to tell you how much I enjoy your magazine, and now after reading the June number I can resist the temptation no longer.

First I read "Big for His Day." It was fine. Then came "Canyons under the Sea," with heightened joy. "Scylla Was a Squid" really got my blood flowing. Next I pursued "Old Juan" with throbbing enthusiasm. But the height or climax of the crescendo came when I took the High Road to Nature with David Lavender. That brought me right back home. I was born and have lived all my life within a few hours' ride of the Salmon River—The River of No Return—with its mighty canyon and its rushing flood of water and detritus. . . .

RALPH TELCHER.

Granville, Idaho.

★ ★ ★ ★ ★ ★ ★

HONORS

Dr. George Gaylord Simpson has received the distinction of election as "Honorary Advisor" to Venezuela's modern and progressive Museo de Ciencias Naturales, in Caracas.

* * *

Dr. Margaret Mead, Assistant Curator of Ethnology at the American Museum, was honored by the degree of Doctor of Laws from the New Jersey College for Women, Rutgers University, on June 1.

* * *

The honorary degree of Doctor of Science was conferred by Brown University on Dr. Robert Cushman Murphy, naturalist, explorer, and Curator of Oceanic Birds at the American Museum of Natural History.

* * *

The national Museum of Anthropology of Mexico has bestowed on George C. Vaillant the title of Honorary Professor, "an honor which the Museum has reserved not only for people who have advanced archaeological science in Mexico in an extraordinary way, but also for those who have manifested in their work their friendship and understanding of the country. . . ." Doctor Vaillant has served the American Museum of Natural History as Associate Curator of Mexican Archaeology since 1927, but early in September he will take office as Director of the University Museum of the University of Pennsylvania, in Philadelphia.

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

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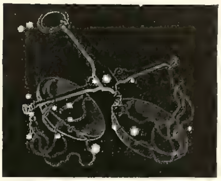
Presents During SEPTEMBER:
"A TRIP AROUND THE WORLD"



In September Planetarium visitors will fly around the world at the rate of 5000 miles a minute. Starting from the familiar skies of New York, they will watch the stars constantly changing during the 25,000 mile voyage. A stop at the North Pole will show the unsurpassed beauties of the Northern Lights with all their color and movement. At the South Pole the brilliant midnight sun will turn night into day, moving slowly around the horizon day and night.

●

THE HAYDEN PLANETARIUM
Presents throughout OCTOBER:
"MYSTERIOUS MARS"

In October the Planetarium will present our neighbor in the solar system that has always been of great interest to us—Mars. From early Greek days, when Mars was a mere symbol, until to-day, when the great telescopes of the world reveal a mass of data on this ruddy planet, Mars has caught the imagination of the public. Is Mars inhabited? What are the "canals" of Mars? What will the future tell us about the curious markings now seen so indistinctly in even our best telescopes? How about an invasion from Mars? These and many other interesting facts will be presented in a most dramatic and colorful spectacle.

●

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LETTERS

SIRS:

. . . I enjoy the Magazine so much and hope it can always continue. It is lovely in every way and so free from the turmoil of the day—I am beginning to think of it as an escape magazine. I will make an effort to send you some new subscribers.

(MRS. J. B.) PARALLEE HAVRE.

Berkeley, Calif.

* * *

SIRS:

I have certainly enjoyed your NATURAL HISTORY Magazine. It is both instructive and beautiful. I am greatly interested . . .

JESSIE MERCIER.

New York, N. Y.

* * *

SIRS:

I am a very happy member and enjoy the Magazine beyond words.

MRS. GEORGE B. LEE.

New London, Conn.

SIRS:

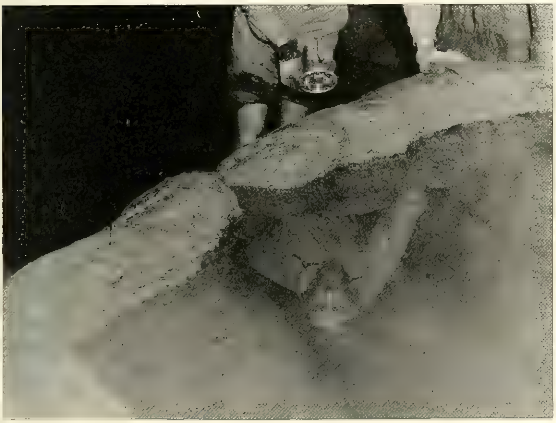
I must thank you very much for your most kind letter dated July 8th saying that one of your American members has graciously sustained my membership during the coming year because of our assets being frozen under the international emergency.

I find it very difficult indeed to express what I feel about such a generous and charming thought and action, and I hope you will let him or her know how very, very much I appreciate this kindness and with what added pleasure I shall now read your delightful magazine. The people of your country are indeed the most generous of givers in small as well as big ways and so often make life gayer and happier by their many kindnesses. I work in a munition factory and your magazine in wartime is a source of real joy and rest. I cannot tell you how much I look forward to its arrival.

Again my best and grateful thanks.

V. MACEWEN.

Somewhere in Scotland.



SIRS:

I am not aware whether you use single pictures in NATURAL HISTORY Magazine but believe that the accompanying photograph possesses unique interest.

This is of a series of strange natural dams dividing a lake in Balls Cave into fourteen sections. The cave is near Schenectady, New York, on the edge of the Helderberg escarpment. Dr. Paul A. Zahl, research associate in biophysics at the Haskins Laboratories in New York, and myself, have been investigating these dams for the past few months, and as far as we are aware they are the only ones of the kind. The underground water is frequently so high as to make careful exploration and examination impossible.

The dams are of limestone origin and are probably the result of a chemical precipitation. They range from eight feet high at the deep end of the lake to about six inches at the shallow end. The dam shown is the largest of the thirteen, and the water it impounds is about ten feet deep.

DUANE FEATHERSTONHAUGH.

Schenectady, N. Y.

* * *

SIRS:

. . . Our entire family take such pride and joy in keeping your magazine and having the binders for each year. They not only enhance the bookcase but keep people from borrowing the single issues. I don't object to lending books on principle but everyone really should have his own NATURAL HISTORY Magazine because it's so fascinating and interesting. It just tells you

Continued on page 190

LONGINES
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THE FIRST RADIO time signal broadcast was read from a Longines Chronometer on N.B.C.'s Station WJZ in February, 1927. That Longines Chronometer was an important instrument in broadcasting operations. To switch programs from one studio to another or to join several stations in a hook-up—in 15 seconds or so—the watches in each place had to agree to the second with all other watches in the system. This was a major time problem. The problem was solved through the use of Longines Navigational Chronometers, hundreds of which went into broadcast station service. Truly, in radio broadcasting also—Longines is the most honored watch.

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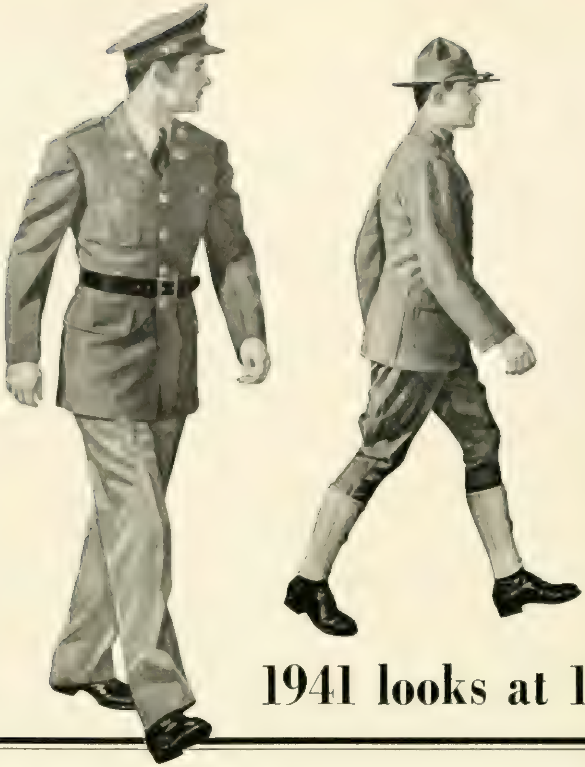

1941 looks at 1916

THINGS have changed a lot in 25 years and yet there is much that is the same.

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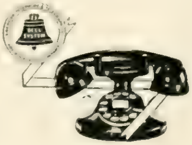

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The Magazine of the American Museum of Natural History

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ROY CHAPMAN ANDREWS, SC.D., Director

VOLUME XLVIII—No. 3 ★ ★ ★ ★ ★ ★ ★ **OCTOBER, 1941**

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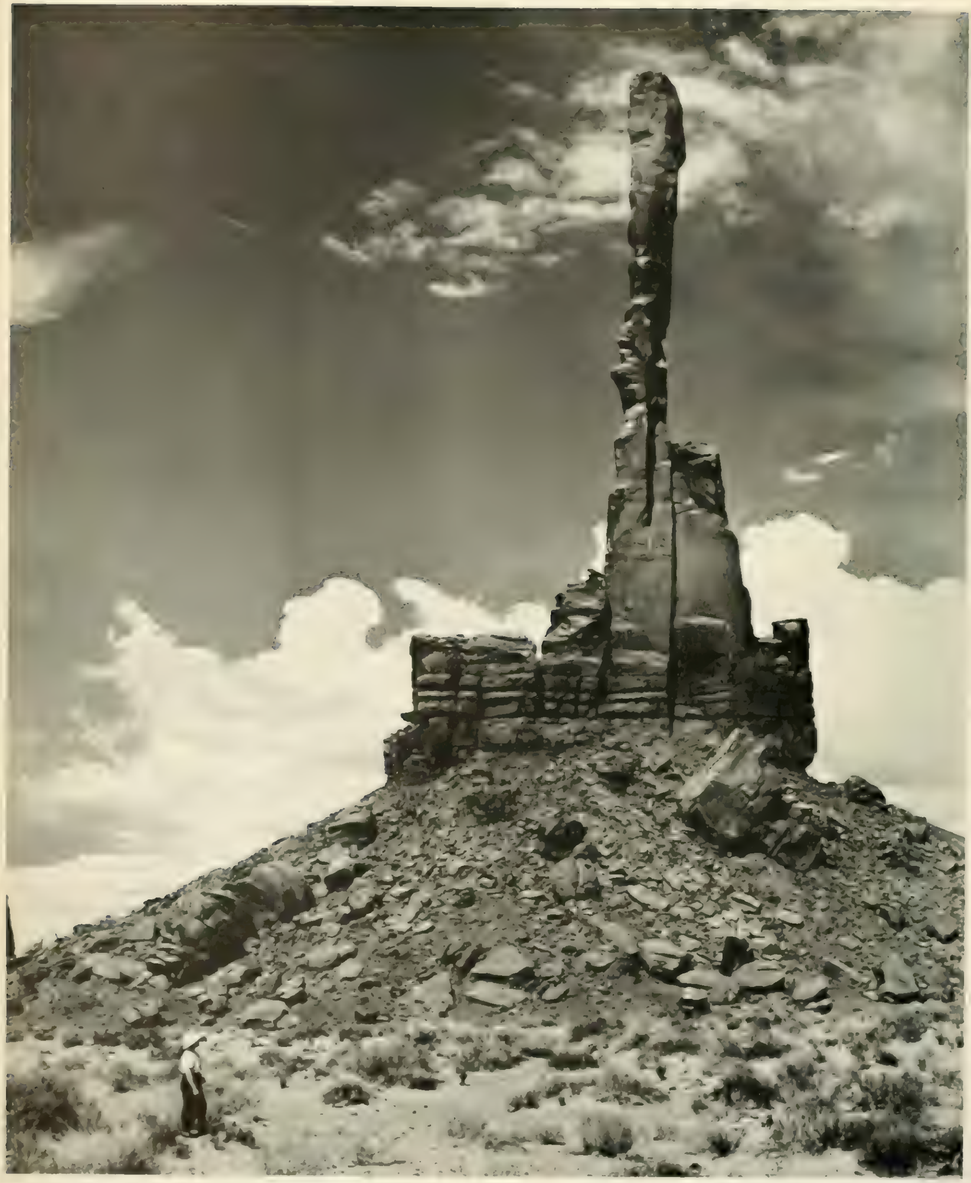


TOTEM POLE: a slender spire which towers nearly a fifth of a mile into a sapphire sky. Nature's cutting makes it resemble a gigantic totem pole carved by the Indians. Fewer travelers have seen this than most of the other monuments, for it stands well out from the center of the valley

SKYSCRAPERS
OF THE DESERT

By JOYCE ROCKWOOD MUENCH

Photographs by JOSEF MUENCH

WHEN the sun comes up over Monument Valley's unique skyline it shines on Goulding's Trading Post, the most remote spot in the United States,—over 130 miles from any railroad.

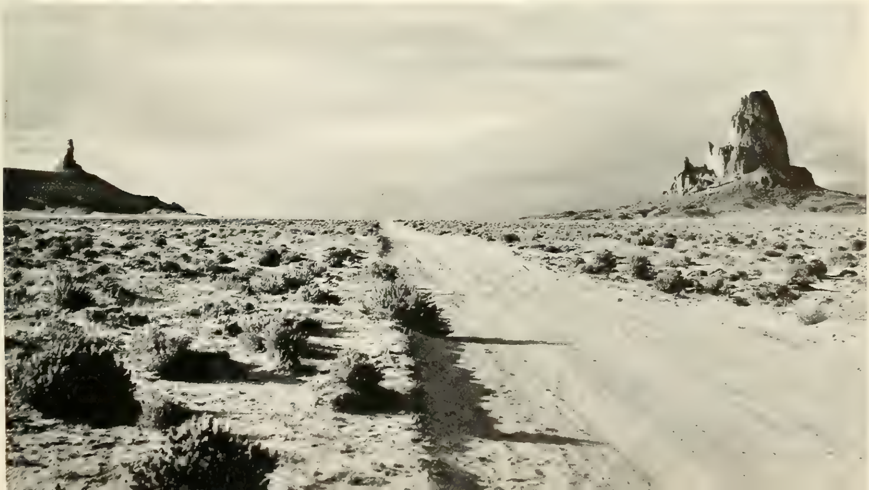
Far and wide in every direction spreads a landscape whose fantastic beauty ranks high among the foremost spectacles of Nature. Monument Valley has not been set aside as a National Park or a National Monument, and its age-old sculptures look down upon a scene unsullied by surfaced roads or other works of man. When you set out from Kayenta in northern Arizona over the road shown in the photograph below, you may drive all day through this weird scenery, up past the Goosenecks of the San Juan to the nearest paved road in Utah, without, perchance, passing a single car. And at times even the sociable traveler may be glad of this, for there are stretches where it would be quite impossible to pass another automobile.

Ages ago a great plateau existed over what is now southeastern Utah and northeastern Arizona. It was made up of layers of rock of varying degrees of hardness. Rivers carved their courses down into this plateau, then widened them, and left a multitude of towering tablelands. As time went on, these yielded further to the elements without losing their tremendous height; and as wind-driven sand added its share to the work of rain and frost, an assortment of columns and spires was formed which has no rival. In height they range from 800 to 1200 feet above the valley floor.

Before the water was gone, antelope were hunted here by the Indians, who drew crude pictures of them on the soft sandstone walls in some of the canyons. Water is scarce now, and there are no antelope. Descendants of the early Indians still live here with small flocks of sheep and goats that enable them to eke out what seems to many a miserable existence in a desert country. The men of the family tan hides and make shoes or beat jewelry from native silver and set it with turquoise. The women weave the wool of the sheep into the beautiful, durable Navaho rug and saddle blanket that is sold all over the world. To the family who produce it, it represents trading power to secure flour, sugar, coffee, and tobacco.

To the modern Indian, as it must have been with his ancestor, home is any spot under the shade of a tree where the family puts its jumble of household goods and builds a fire.

(Below) GATEWAY TO A STRANGE WORLD. The twin sentinels of Owl Butte and Algothla guard the road on either side as the motorist enters Monument Valley from the south. He has already left the traveled highway far behind and is over 100 miles from the nearest railway. Once through the gate, he looks out upon a scene of unearthly beauty, with breath-taking vistas of at least 50 miles in either direction



[illegible] Together they make a gateway to a strange world.

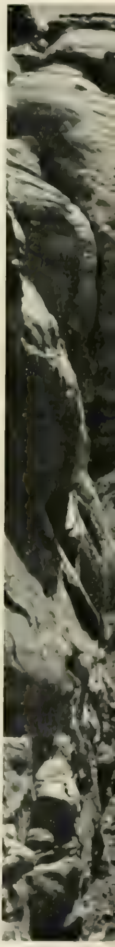
It is a gateway to a valley unique in a country of [illegible] tive, and these great mesas look close even when they are miles away. Vistas of at least 50 miles in either direction are open to the eager eye. Carved on a scale grander than that used in most of Nature's works, the Mittens for example, need a pair of hands about 800 feet from wrist to finger tip. Brigham's Tomb dwarfs the Pyramids of [illegible]. The Totem Pole rises [illegible] and slender 1000 feet above the valley, carved as delicately as the Alaskan Indian's hand-made pole in front of his lodge.

Here is an enchanting land which is being "discovered" by more people every year. Its horizons are matchless, and the Indian, part and parcel of the land, is always fascinating. Today this place is still primitive, untouched. Tomorrow the hand of commerce may brush the bright bloom from it; then those who have seen it while it was still "unknown" will remember it as one of the most spectacular sections of our western frontier.

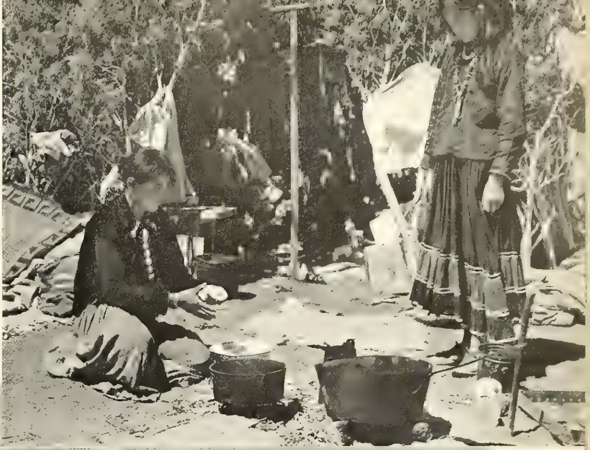
(Left) DESERT SKYSCRAPERS, over which brilliant clouds chase a constantly shifting procession of shadows. Here Merritt Butte sulks in the gloom while some of the more distant monuments gleam like a city of gold. Their flat tops mark the level of the plateau that stood here eons ago, before the forces of wind and water carved it away and left these lonesome, majestic reminders

(Left, below) THE MITTENS. A pair of hands 800 feet from finger tip to wrist would be necessary to wear them. The left-hand mitten is three miles from the camera, the right-hand six. Merritt Butte, on the right, is named for a prospector who was killed by Indians for robbing their silver mine

(Right) ONE OF THE MITTENS as seen through the gap. A close-up of one of the formations shows the layers of rock over which the débris has tumbled as the pedestal was shaped and the upper portions of the monument carved by sand, wind, and water

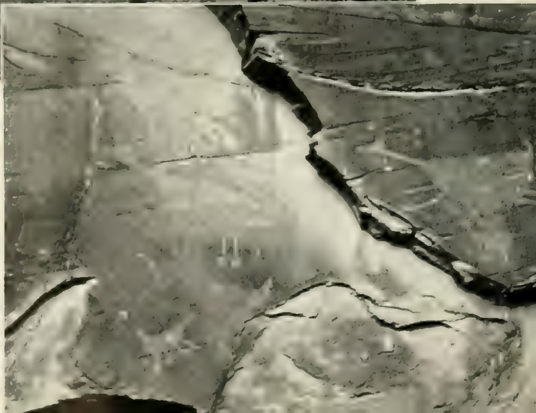


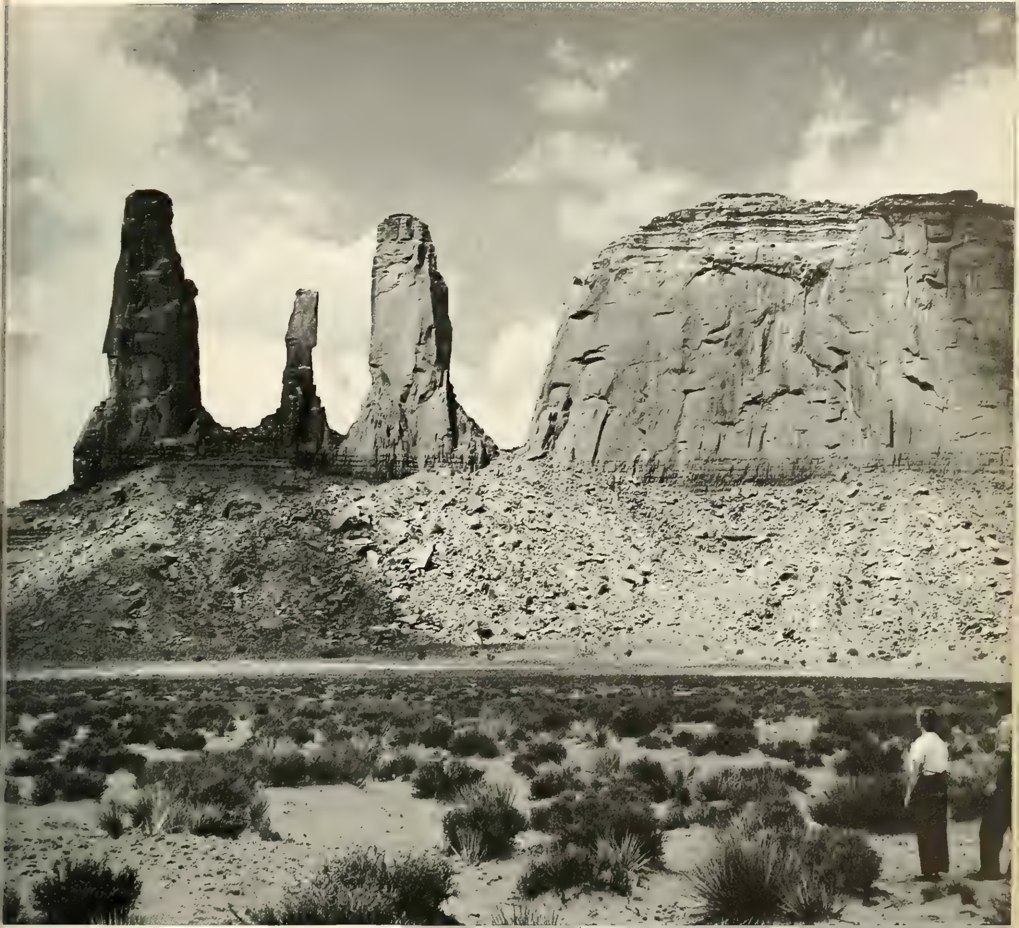
(Right) DESERT HOUSEWIFE. Among the many hundreds of Navahos that live in this natural wonderland, home is where you rest your head for the night. The household goods are strewn on the ground, and woman's work is never done. Here a squaw is preparing bread for baking, while her younger sister watches the process with interest. The simplicity of the velveteen blouse lends itself to the effective display of the ornate silver and turquoise jewelry



(Above) AMID THE FLAMING CLIFFS and turrets of Monument Valley, man feels the insignificance of man. Heat and cold, moisture and drought, have aided Nature here in her timeless art

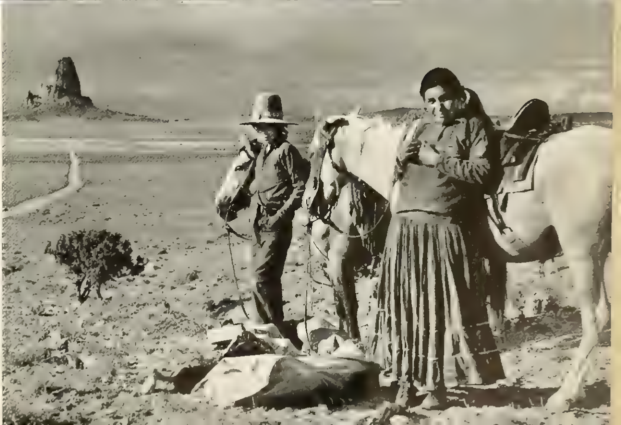
NOW AN ALMOST WATERLESS DESERT, Monument Valley once supported antelope, probably several hundred years ago. The game that then survived in a damper climate can still be seen from the hand of some Indian artist who stood upon the sand and with some rough tool scratched the surface of the soft sandstone *(right)*



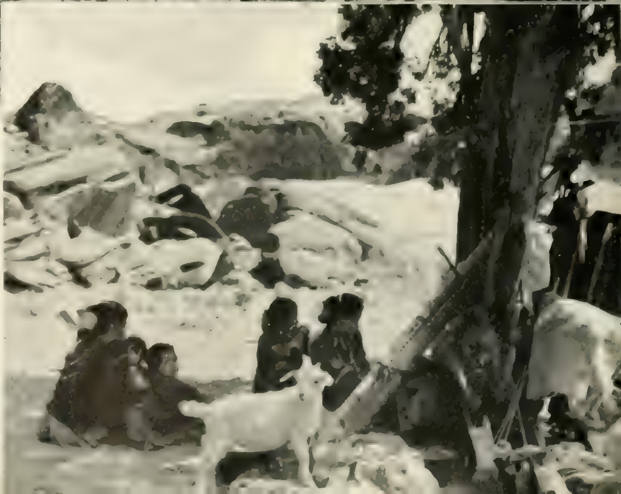


(Above) THE THREE SISTERS. The procession makes its way, into the cathedral at right, where the tiny novice in her veil may take her vows. The prioress who takes up the rear carries her hands neatly folded, and even her features can be seen on closer scrutiny. The figures rise over 800 feet from the floor of the valley. In winter you may see them wearing veils of snow

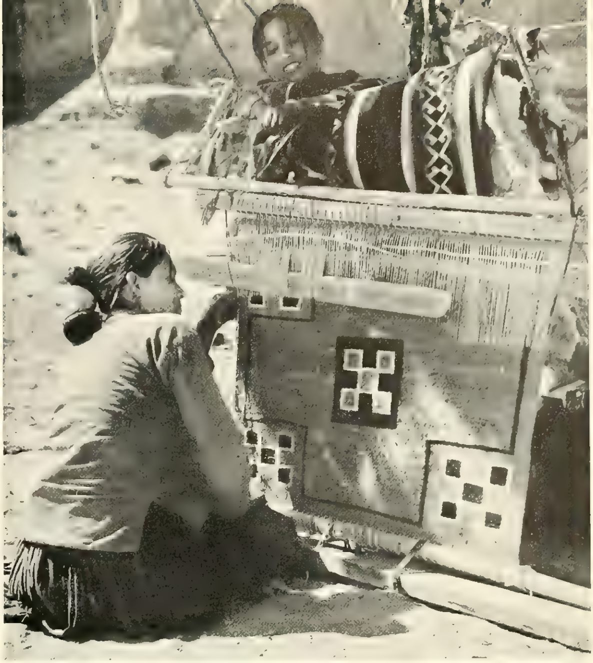
(Right) DESERT NOMADS: two Navahos who have stopped for a bite to eat on a ride home from the trading post. The desert road leads toward the monolith Algothla, which unlike the others is volcanic rock



Brilliant colors suffuse the skyline as the desert sun paints the massive sandstone blocks like Pop's Mesa *(above)* a richer red. This mass at times looks like a great red elephant charging down upon the road

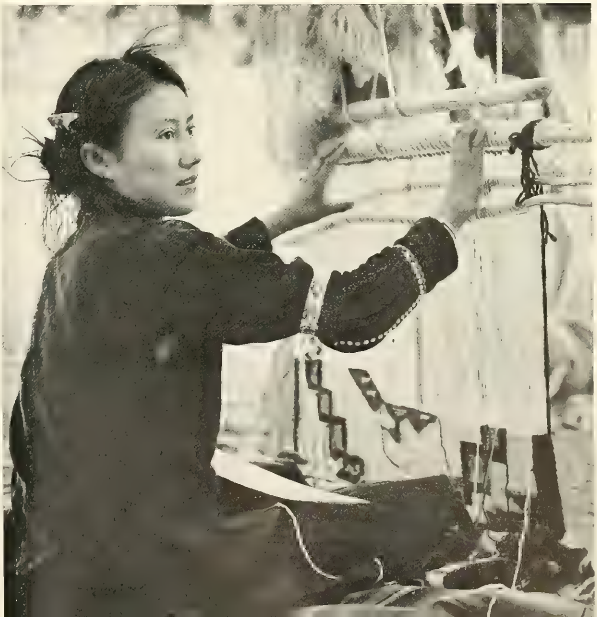


(Right) Against a background of red rock, these Navaho women and their children rest in the hot noonday. The young goat has the run of the "house." A blanket loom is propped against the tree, and jerked meat can be seen hanging from a rope at right



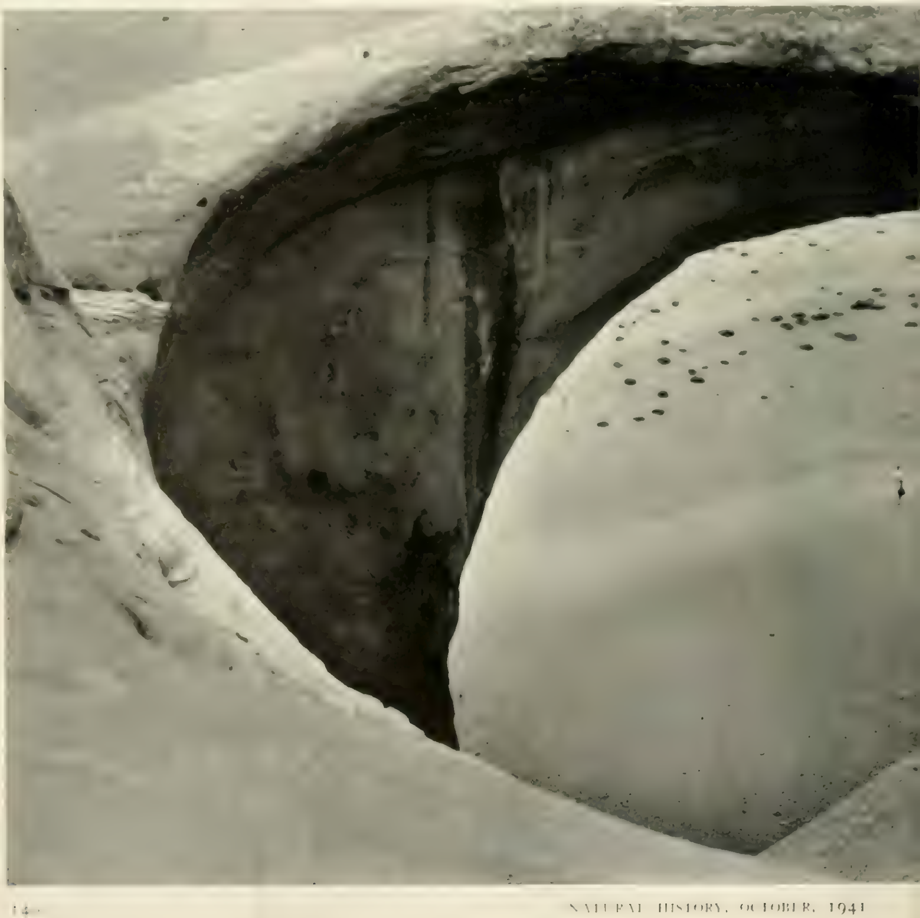
(Above) Workshop in the desert. The Navaho weaver always finds a place to hang up her loom and continue work on her rug. The patterns, we are told, no longer have symbolic meaning. Even the small girls are interested in the weaving and seem eager for the time when they can practice on their own loom

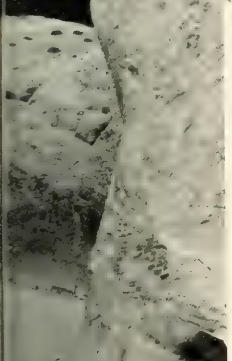
(Right) Wool raised on the family flock is used in weaving the beautiful rugs. With the proceeds from sale of them the Navaho buys flour, sugar, and other supplies. The usual Navaho dress is here varied by sleeve band and buttons—signs of Piute influence



(Left) AN ENDLESS VARIETY of such vistas offer their beauty against an ornately clouded sky in Monument Valley

(Below) AN EYE in the rock. Sand, wind, and water have here cut a large hole in the top of an open cavern in the cliff. Note the figure on the sand of the valley floor



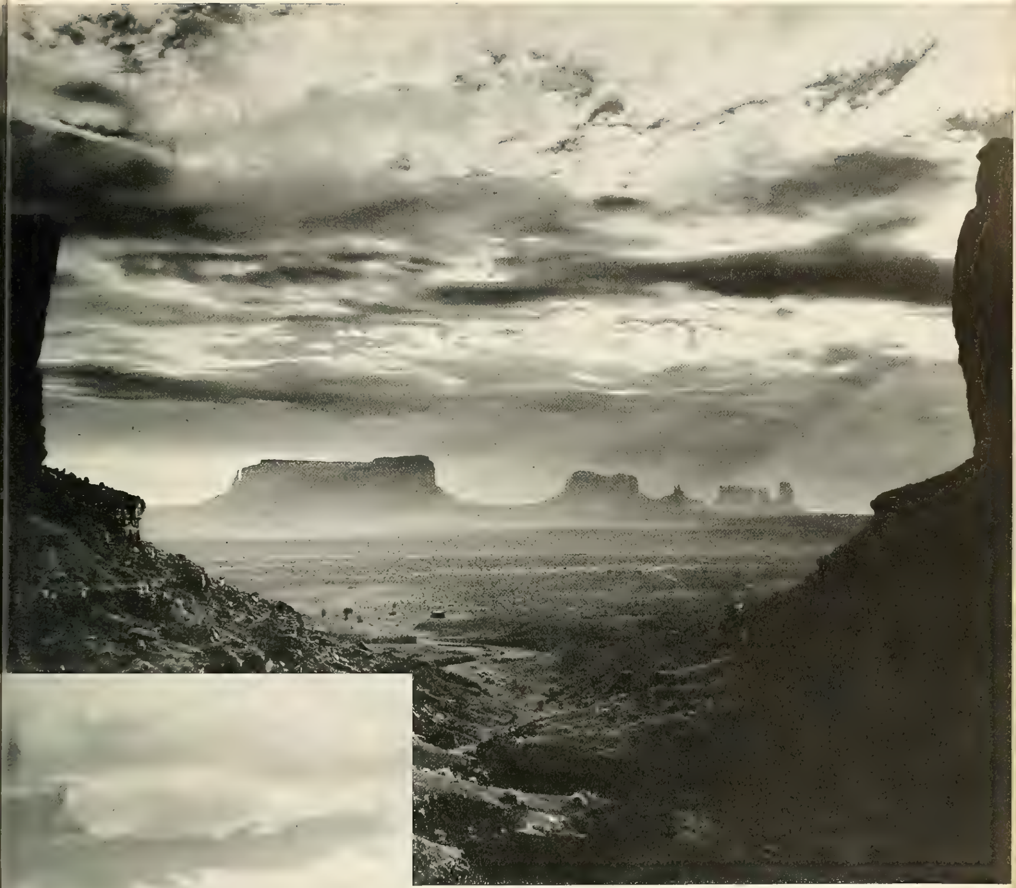


(Above) THE DISTINCTIVE BEAUTY of Monument Valley comes from the great sweeps of barren ground surmounted by curious shapes of brilliantly colored sandstone, rising into cloud-strewn skies like this

WATER IS SCARCE in this land, but the Navaho usually knows where to find it for himself and his inseparable companion, the horse

(Above) Like a gem of great size in the most unusual setting, Merritt Butte is here seen through the branches of a scrub juniper tree—a symbol of Nature's majesty, which will doubtless stand long after man's works have been disfigured by time

(Right) Outlined against a desert sky, this Navaho represents all Indians who still cling to the freedom that their horse gives them and the strength that the desert demands



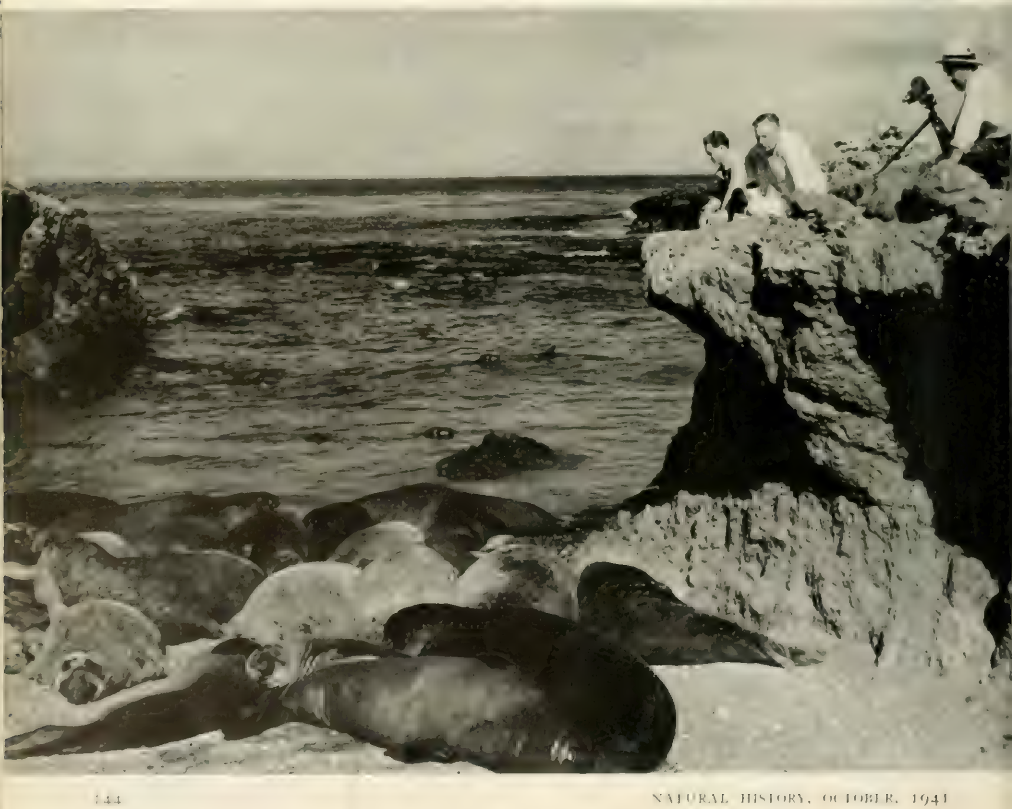
(Above) THE LOW LIGHTS give Monument Valley some of its most sublime pastel shades, as when the sun, struggling through gathering clouds, casts a soft mist over the landscape and touches the thin carpet of desert growth with light. A winding road can be seen approaching the lonely hut and coral, over which moonlit night will later cast a matchless spell of solitude, amid scenery unsurpassed for sheer grandeur perhaps anywhere on earth

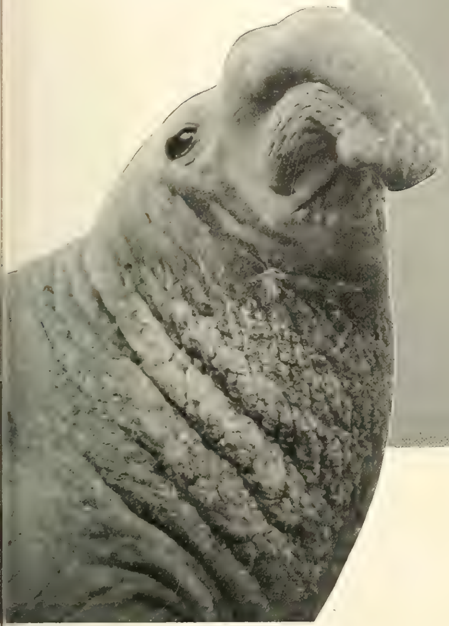
After a period of slaughter which threatened to exterminate this picturesque mammoth of the sea, rigid protection may enable layman and scientist alike to observe its interesting habits on the islands off the California coast

J[illegible] projected vertically two or three feet above the [illegible] As the ship approached closer, several observers almost simultaneously [illegible] "Sea elephant!" [illegible] seen such a creature, but all guessed its identity almost [illegible] of its mouth. The animal remained motionless regarding [illegible] for a few moments, finally [illegible]

In 1884 Dr. Charles H. Townsend, former director of the New York Aquarium, made an extensive [illegible] along the Pacific coast of Lower California searching for specimens of the Northern Elephant Seal, or Sea Elephant. During the trip he was able to obtain only sixteen specimens at San Cristobal Bay, which were prepared for the United States National Museum. Numerous bleached bones of the elephant seal were found along the coast and on the offshore islands, attesting to the former abundance of the species, whose range once extended from Cape San Lazaro near Magdalena Bay, Baja California,

QUIET: please go away and let us sleep. A congregation of sea elephants in a rocky cove on East Bonito Island off the coast of Mexico's Lower California, indulging in their favorite pastime. The herd consists principally of adult females who lack the ten to twelve-inch trunk. A pup nestles between two hulks in the foreground and a young awakened bull rises in protest, lending action for the cameraman





THE TRUNK contains inflatable air chambers and flap-like valves which close for diving. A rumble is sometimes emitted which gains resonance in its fleshy interior

JUMBO *of* THE DEEP

By WOODBRIDGE WILLIAMS

to Point Reyes just north of San Francisco, California. The decline of the elephant seal was due to the extended activities of sealing and whaling ships which sought this peculiar animal for its bountiful supply of valuable oil.

Again in 1911 Doctor Townsend investigated the realm of the sea elephant on board the United States Bureau of Fisheries' ship *Albatross*. To his surprise he found on the then uninhabited Guadalupe Island, lying off the northern coast of Lower California, a herd of approximately 125 northern elephant seals hauled out on Elephant Beach on the northwest side of the island. Since the rediscovery of the species, there has been a substantial increase in the number of seals on Guadalupe Island. A good deal of the credit for the come-back of these animals is due the Mexican Government, which has afforded them protection for the last eighteen years through the maintenance of a garrison of soldiers on the island for this purpose.

For many years Guadalupe Island was considered to be the only locality where the northern elephant seal landed, or in the sealer's terminology, "hauled out" on the beach. But Doctor Townsend, enthusiastic over the increase of these seals, which he formerly believed approaching extinction, optimistically wrote in NATURAL HISTORY Magazine (February, 1924), "The casual reappearance of the Elephant Seal at other islands from Cedros northward to the Santa Barbara Islands may reasonably be expected."

It was in October, 1940, that the *Velero III*, belonging to the University of Southern California and used for marine exploration under the auspices of the Allan Hancock Foundation, had sighted an elephant seal far to the north of Guadalupe Island, off Point Vicente, just west of the busy port of San Pedro, California. During the last few years, one and sometimes a few more elephant seals have been seen swimming in the sea or hauled out on the islands, off the coast of southern California. These islands are collectively known as the Channel Islands, or the Santa Barbara Islands, as referred to by Doctor Townsend. The Allan Hancock Foundation feels that at present it is not wise to publicize the definite localities where elephant seals have recently been observed on the Channel Islands. Rigorous protection of these animals from molestation by yachtsmen and fishermen is absolutely necessary to insure the continued increase of sea elephants on the islands off the coast of southern California. Despite the still few numbers of elephant seals in this region, the fact remains that Doctor Townsend's prediction of seventeen years ago has been borne out, and in its entirety: for the sea elephants, as well as coming north to California, are going south to breed on islands long vacated by their kind.

In 1933, while searching for elephant seals in preparation of a group for the Field Museum of Natural History, the *Velero III* chanced to visit [illegible] island coastline. The situation was quite in contrast [illegible] indication that the northern elephant seal was once abundant on the island.

This year the island again teemed with sea mammals. In late February, 1941, the skiff from the [illegible] into a cove surrounded by crags except at the farther end where small waves broke on a boulder-strewn beach. Pods of pup sea lions dotted the kelp-streaked water with their shiny dark heads, accompanied here and there by a larger cow. In contrast to the actively [illegible] most of which rapidly floundered into the water upon our arrival and swam gracefully about the skiff, barking like so many frightened dogs—great, dirty brown forms, ten to fifteen feet in length, lay high on the strand, almost completely unconcerned over the hesitantly approaching skiff. One lumbering elephant did make a half-hearted attempt to leave the beach but was carried by its ambition only as far as the water's edge, where it bogged down, lying half submerged and greatly suggesting a floating hippopotamus in an African river. One elephant seal swam leisurely about in the cove, making the landing party a bit apprehensive over the animal's potential ability to upset the skiff. But it soon seemed evident that the creature was incapable of planning such an attack.

With the scraping of the skiff on the beach, the party scrambled and waded ashore, then leisurely photographed and observed the sleeping hulks, as if they were prepared specimens behind plate glass in some museum. All that was missing was a tag reading: "Northern Elephant Seal, *Mirounga angustirostris*." Only occasionally would one of the listless forms rear on his foreflippers and bend his neck far back to emit rumbles which seemed to start deep in his throat and gain resonance in his fleshy proboscis. The sound was one which a seasick person certainly would not care to hear. The sea elephant would hold this position for a moment, then flop back onto the beach, or more often onto the body of a sleeping companion. With a few sweeps of his foreflippers he would blanket his back with sand as protection from the rays of a semitropical sun. Soon pits would form in the sand beneath his nostrils from silently exhaled breath. The creature was happy again, for he was fast asleep.

Only after much provocation by means of rocks was one of the bulls convinced that we wished him to perform by moving toward the water. He accomplished the feat by using the foreflippers as vertical levers. The forward motion was initiated by the lifting of the body just in front of the hind flippers, forming a contraction which traveled toward the head. These movements suggested the muscular waves [illegible] though the sea elephant was far less graceful. He accomplished progress by much grunting and scraping of cobblestones on the beach. The hind flippers were not directly used but simply dragged along on the sand and over the rocks.

The cove of landing sheltered a group of bulls; but in other indentations to the west there were a number of cows, smaller, about ten feet in length, and lacking the short trunk of the adult male. Accompanying a good many of these cows were plump pups, so round and fat that they could hardly move. Sleek and shiny these infants were, quite in contrast to the bedraggled, almost emaciated appearance of their elders, who at that time of year were shedding their skins in much the same manner as do humans who have acted like seals on a beach for too long a period of time. The adults seemed to feed little during shedding, as they appeared to have lost a great deal of weight.

Exactly how old the young pups were, or where they were born, was somewhat of a mystery. Little is known concerning the life histories of these animals, although Mr. Lawrence M. Huey of the San Diego Society of Natural History reported in 1926 that the remains of four small elephant seals (about 30 inches in length) on the beach at Guadalupe Island would seem to support the assumption that their cycle had begun on that island.

One could walk right up to the youngsters on East Bonito and stroke their smooth gray backs. They only occasionally objected by lifting back their heads, opening their pink mouths, and hissing in lazy protest. Besides these newly-born pups, numbers of yearlings were distributed among the ill-sorted piles of unconscious adults. The sex of these youngsters was very difficult to determine from superficial observation.

East Bonito appears to have become once again a breeding ground for the elephant seal. It is interesting to note in comparison that in 1933, when the *Velero III* visited Guadalupe Island, only large bulls were seen. At that time a seventeen-foot specimen was taken for the Field Museum of Natural History; its estimated weight was 5,000 pounds. Some observers have commented on the absence of young and females on Guadalupe Island, while others have reported their presence. There is yet much to be learned concerning the yearly meanderings of this interesting animal.

The feeding habits of the northern elephant seal have long been a source of much conjecture. Only scanty information has been obtained from examining the stomach contents of the animals taken on the beach. Usually no food was found, only "ballast," as sealers term it, consisting of rocks and sand. But Dr. A. W. Anthony of the California Academy of Natural Sciences reported finding in the stomach of a Guadalupe sea elephant one whole fish, which had been bolted, a squid and some seaweed. The stomach contents of a specimen taken by the *Velero III* in 1933 yielded squid and seaweed. Because of the usual empty condition of the stomachs and the fact that the animals have large lustrous eyes resembling the so-called "night eyes" of nocturnal mammals, most zoologists believe that the animals are more active at night, doing their feeding at that time. The two specimens in the San Diego Zoo, on the contrary, are fed twice daily, consuming about 60 pounds of sardines. Mrs. Belle Benchley, Director, reports that she has not been able to observe any differences in the animals' activity, day or night. Of course, the artificial environment may account for such a discrepancy.

The most complete report that has been made concerning the feeding habits of the northern elephant seal was made in 1930 by Mr. Huey, who examined the stomach contents of a specimen harpooned by a fisherman 40 miles off San Diego, California. The harpooning itself was quite significant at the time, as no elephant seals had been reported so far north for many years. But what this animal had consumed for lunch was even more surprising. The meal consisted of seven ratfish *(Hydorlagus colliei)*, one California dogfish shark, one puffer shark, three skates, and four squid. The study brought out several significant facts. The ratfish was the most abundant form represented, and as it lives in water from 50 to 120 fathoms deep, its presence seemed to indicate that the elephant seal had dived a comparable distance for its meal. From the evidence given by the fisherman, the sea elephant was feeding some distance offshore, and during the day. The intact vertebrae of the dogfish shark indicated the food was bolted, probably alive, as the elephant seal has poor dentition for mastication, its teeth being set quite far apart. Mr. Huey attributes the success of the elephant seal in deep-water feeding to its large eyes, which are probably quite effective when swimming far beneath the surface of the sea.

From the evidence the questions arise: does the sea elephant feed in two distinct areas—one while near the breeding or hauling grounds on the islands, where it would feed on marine vegetation and shallow water fish and invertebrates, and another in deep water, far offshore where it must descend many feet to obtain a meal? Or does the adult sea elephant, for the most part, fast while on the islands and do most of its heavy feeding in deep water? Since we found some evidence of food in the stomachs of seals taken on the beach and the cows with pups might be expected to require nourishment, it seems likely that the animals do feed, as least to some extent, along the shores of the islands. This probably occurs at night, as most of the animals remain quite inactive during the day. When migrating at sea, it would seem from the evidence presented by Mr. Huey that the real banquet tables of this animal are in the deeper offshore waters.

Taming of the elephant seals has presented extensive problems to the San Diego Zoo. One specimen took 157 days to make up its mind that the zoo menu was acceptable. All that time force feeding was in order and required somewhat elaborate equipment. A large canvas with an aperture for the seal's head was constructed and used like a poncho to protect the animal from the handling necessary with force feeding. The animal was induced to place its head through the hole in the canvas by holding food on the opposite side. After he had been shrouded in canvas, a padded iron bit was thrust into his mouth to hold it open for the ensuing procession of fish. When the stubborn animal finally did condescend to eat on his own accord, he at first required the stimulus of the canvas before he would take the proffered meal, despite the fact that the canvas was no longer used in the actual process of feeding. The specimen lived for seven years in the San Diego Zoo—which is the longest period that institution has been able to maintain an elephant seal. The animal's career was terminated by the introduction of a large bull, which continually forced the smaller animal against the cement sides of the tank, finally killing it.

Despite the artificial surroundings and environment, zoo animals do shed some light on their habits in the wild. An interesting faculty of the northern elephant seal easily observed in the pool is the length of time the creature can remain underwater. One specimen seemed to enjoy relaxing under the shade of an overhanging shrub where he periodically submerged his head just beneath the water. Occasionally his head would break the surface and the animal would blow, making a sound like a person very much out of breath. Only for a short spell would he remain at the surface, then down he would go again. The submersion lasted on an average around three minutes, although his companion disappeared beneath the pool for a period of five minutes. Mr.

[illegible] time in breath-holding.

Many diving mammals close the nostrils so as to prevent the entrance of water. Young specimens of the northern elephant seal do this; but older ones, at least the adult males, do not [illegible] the nostrils —they have a different modification for the purpose of diving. Mr. H[illegible] reports that in both nostrils [illegible] flap-like valves that can be closed or opened at will. Also there are air chambers in the proboscis which the animals can inflate, causing [illegible]

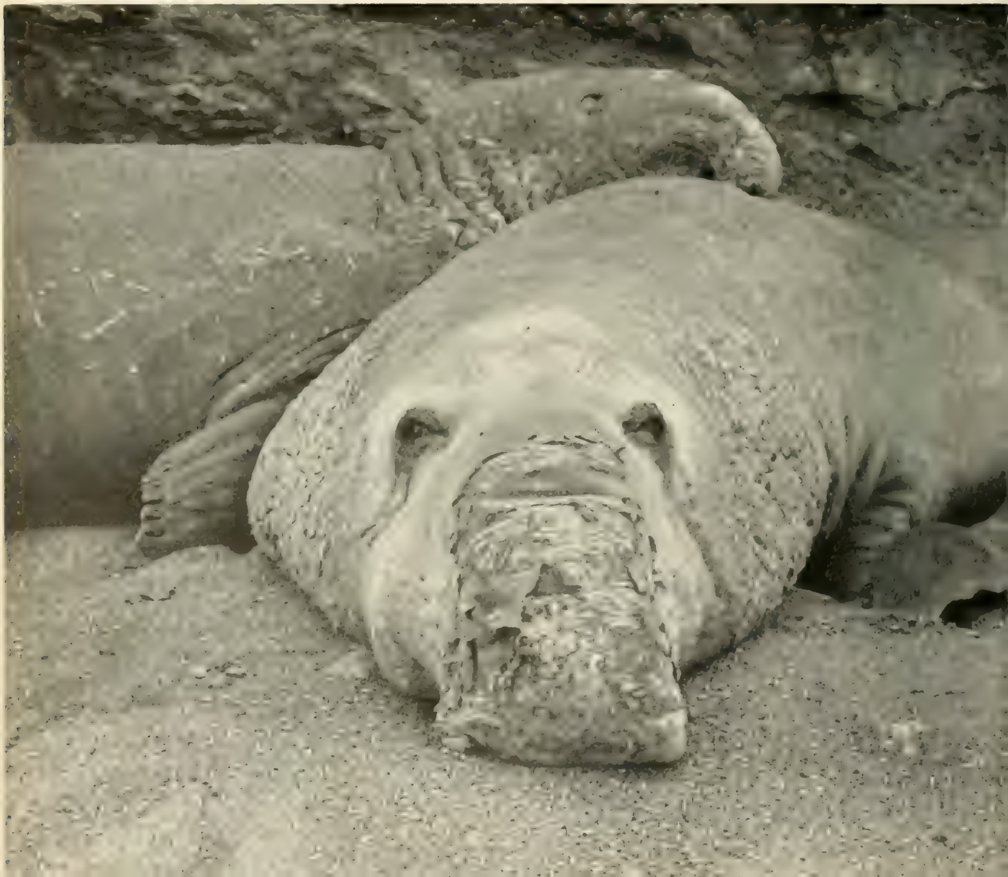
[illegible] the proboscis with its air [illegible]

The swimming methods of elephant seals can readily be observed in the zoo. When one of these seals is fully under way beneath the water, the powerful hind flippers so useless on land operate very much like the tail of a shark, propelling the animal along with a thrashing movement. Only when the seal is slowly cruising along the surface do the fore-flippers come into play, acting as balancers and perhaps aiding somewhat in propulsion like the pectoral fins of a fish. At this time the hind flippers, held rather far apart, propel the creature with a vertical flapping or sometimes a scissors action.

The larger specimen of the two young males now in the San Diego Zoo enjoyed swimming beneath the water along the visitors' side of the pool.

IN BATTLE, the proboscis is a major objective, as shown by the gashes on the trunk of this large male. The heavily calloused chest serves as a sort of shield, portions of which can be seen here. The warring opponents seem not to care whether this portion of their ponderous anatomy is injured or not. The fighting of these seals is not so serious as that of the fur seals, which is often to the death. "Sunburn lotion" in the form of sand thrown over their backs is visible in this photograph

[illegible]

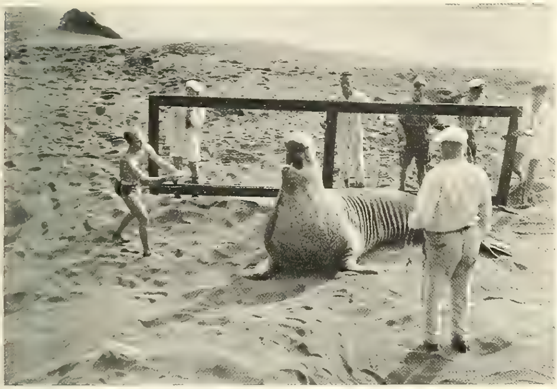


Then, slowly emerging on the opposite side, he cruised along with just the head and proboscis above the water, blowing small jets of water in front of him with his breath. His head would be constantly turned to one side, pointing toward the edge of the pool closest to him, and one might wonder at first why he persisted in this. But the secret was soon revealed by a clatter up the road.

A truck appeared above the pool. The two Steller sea lions living with the elephant seals already had their foreparts up on the concrete walk. For a change the usually listless sea elephants showed surprising energy, hauling completely out of the pool to take their breakfast of sardines directly from the keepers' hands. Gulp—headfirst down the fish would go. No chewing was observable. What a wonderful conservation of energy and time! The zoo was no place for impractical human manners. After feeding, the larger of the two elephant seals stretched out on the concrete for an after-breakfast snooze, while his companion returned to his corner beneath the shrub and continued the incessant bobbing up and down.

The elephant seal is not a graceful creature, nor one with a pleasing "vocabulary," but he is the largest of the seals with the possible exception of his southern relative of antarctic regions. He is unique because of his proboscis, which attains a length of ten to twelve inches, and he is a tempting subject for scientific research and observation.

The home-coming of this animal to haunts long deserted stands out as a notable exception to those numerous species which have not come back. Even as Doctor Townsend predicted the return of the elephant seal to the Californian islands, so may it now be foretold that the layman and scientist alike in the near future will perhaps need not resort to the zoo or expend large sums in traveling to distant islands to see this strange creature, but will observe it "at home," in large herds on our near-by Santa Barbara Islands.



Photos, Courtesy of Allan Hancock Foundation

(Above) **AN ATTEMPT TO HERD** a large bull on Guadalupe Island with the sides from a cage floated ashore. Herding was difficult and apparently useless. When the animal made up his mind, he went into the cage of his own accord

ELEPHANT SEALS are easy prey for the hunter, and their come-back from threatened extinction is largely to the credit of the Mexican Government. Above is the garrison house on Guadalupe Island for their protection

(Below) **HANDSOME** by sea elephant standards: the head of a large bull on East Bonito Island. Notice the scanty dentition and peeling skin about the mouth

THE TRIM *Velero III,* research vessel belonging to the University of Southern California and used on the expedition as recounted, under the auspices of the Allan Hancock Foundation

Courtesy of Allan Hancock Foundation

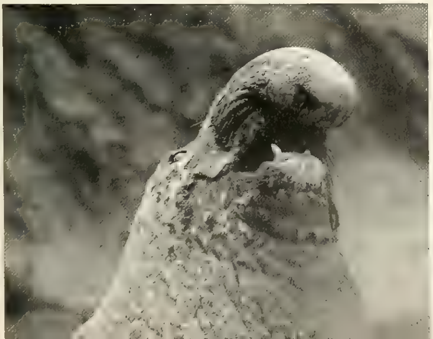
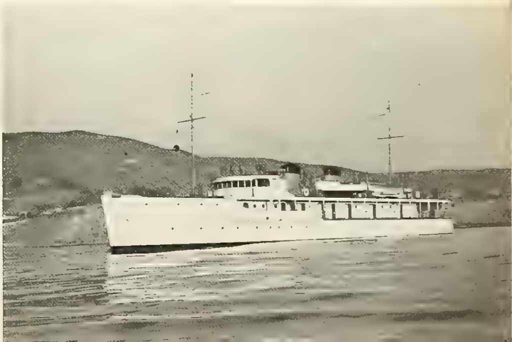


Photo by the author



S[illegible] Dr. Paul B. K[illegible] studying and photographing bears in Sequoia National Park. [illegible] ing sights but nothing comparable to the previously [illegible]. The black bear's average litter is two cubs, with one or three [illegible]. Mother Goofy [illegible] mother in beardom, and her family deserves eminence comparable in their own sphere to that of the Dionne's.

D[illegible] had known Goofy since [illegible] when she herself was a cub. The name was fitting, for she [illegible]. Perhaps it was well that these unusual burdens fell upon a bear with so sporting a disposition, though the world will, of course, never know how she took her first [illegible]. For bears are born in winter while the mother is hibernating under deep snow. The cubs are blind, helpless, and almost hairless—mites that weigh only about half a pound and are about the size of a small chipmunk. The mother often has to nurse the ravenous cubs for three or even four months without a mouthful of food or water for herself.

About 40 days after birth, the four cubs first opened their eyes. They were about three months old before Mother Goofy introduced her unusual family to the forest and began their education.

(Right) MILE AFTER LEG-WEARY MILE the quads trudged after Mother Goofy, learning the ways of the forest. The "wee bear" of this family is the runt. An adverse position at the lunch counter (he had to stand on his mother's arm) might seem a handicap, but by December he had become almost as fat and large as the others

QUADS ON PARADE

An unheard-of event in beardom presented this buffoon of the forest with troubles few mother bears have ever faced and provided a seasoned student of bears with the thrills of a lifetime

By PAUL B. KINNEY
All photographs by the author

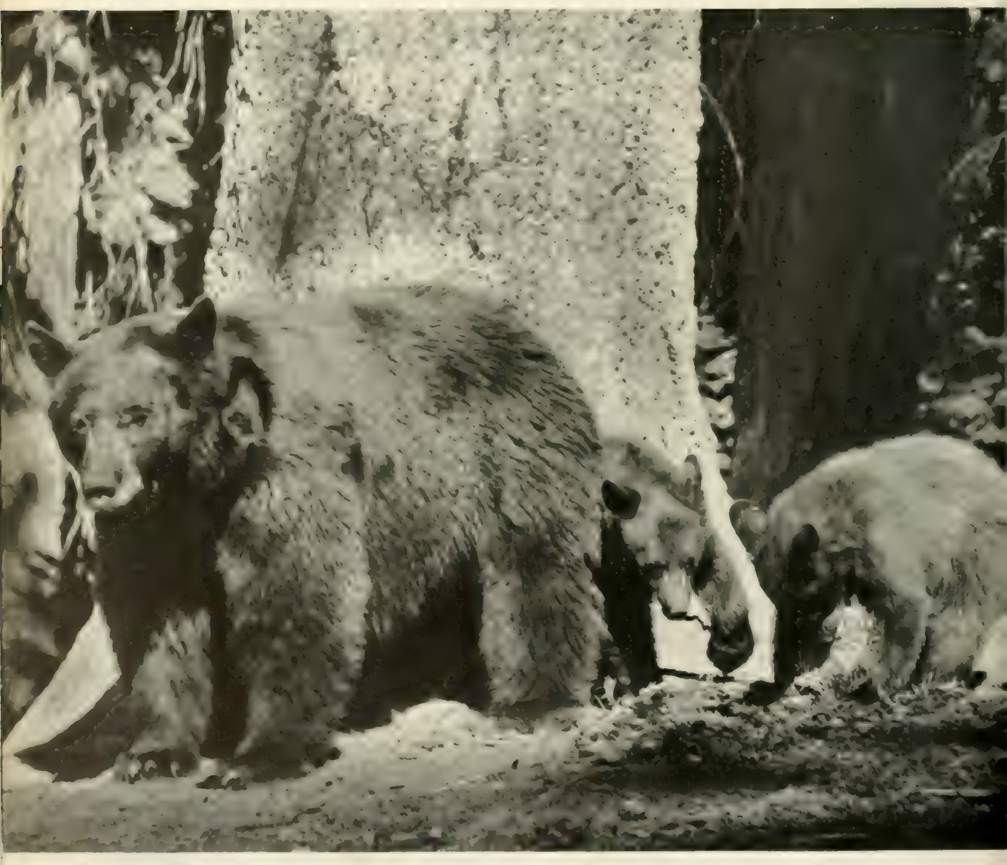
(Left) SAFE RETREAT from danger could be found only in the lofty branches of trees, and one of the cubs' first lessons was in climbing. Experience is the road to skill in this well-known feat of bears, and Mother Goofy was not content until the quads were as much at home in a tree as on the ground. They must learn which trees not to climb, for dead trees are not safe. Nor can a bear climb a sequoia. The author has seen this fact dawn on cubs as a rude awakening, when their claws tore loose from the soft bark and they fell in a bewildered heap

(Right) BEARS DO NOT HUG a tree but climb with their claws like a cat. The sharp, curved claws dig into the bark going up and act as brakes on the descent, which is tailfirst.

Once out of the den, bears no longer use it as living quarters but make their home in the forest at large. When the melting snow exposes the den, they would be at a distinct disadvantage in its confining quarters if attacked by a larger bear

THE PHOTOGRAPHS [illegible] were all taken without a telephoto lens and required a very close approach to the bears. How the bears [illegible] at the time is of very great importance," writes Doctor Kinney. "Cautious, unhurried movements and a low voice—I constantly talk to the animal—often make it possible to get within range. More often than not a bear will snort and puff, chop his jaws and make short menacing lunges toward the intruder. At such times only experience will tell when he is only bluffing or when he means business. If he is bluffing and you stand your ground, the bear will do one of two things: he will lumber off, or he will tolerate the intrusion and calmly resume his activity. Only then is it safe to bury one's face in the hood of a Graflex camera, for on the ground glass distances are deceiving, and it is extremely disconcerting to raise your eyes suddenly and glare into the face of a [illegible]."

(Below) LEARNING TO FORAGE. In August the cubs were old enough to eat solid food, although they still depended largely upon mother for regular nursing. From their independent and often arrogant manners it was evident that they felt quite grown-up. In search of grubs, they tore rotten logs apart with their strong claws, and in the meadows they dug bulbs and sweet roots. They seemed to revel in the sport of tearing open the sticky, pithy cones of evergreens. Berries ripened, and the cubs ate great quantities. Bees and wasps were to the quads what ice cream is to a boy



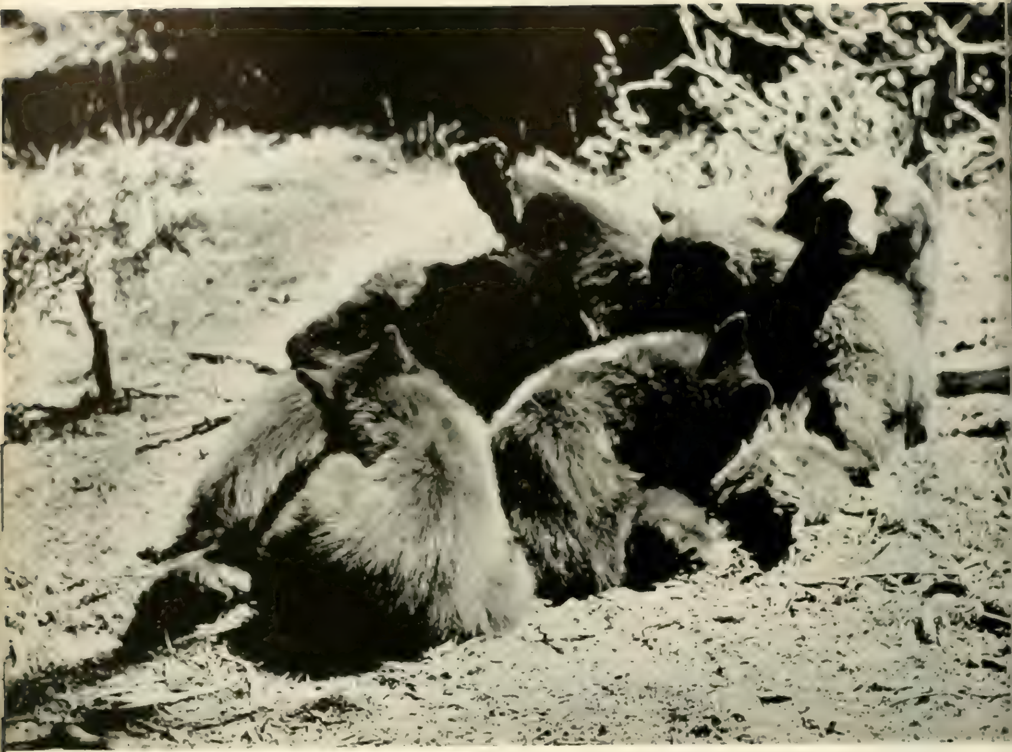
(*Above*) MOTHER ALWAYS STANDS between cub and intruder. A wise man respects this unwritten law of the forest, for a mother bear is easily annoyed. In spite of her clownish temperament, Goofy with four cubs instead of two was no exception.

Each week the quads grew larger and stronger, and their knowledge increased. When they became weary, they climbed into a tree and slept

(*Below*) SPARRING in a forest clearing: two lightweights with heavyweight possibilities. A moment later the cubs were locked in each other's arms, rolling in the duff

AN ANXIOUS MOTHER waits for her family to catch up

(*Right*) CONVENTIONAL NURSING POSTURE: Mother bear with three hungry cubs. With head erect, the mother can spy approaching foes



OBLIGED TO ACCOMMODATE four cubs instead of the usual two, Mother Goofy was faced with a problem. But Nature had provided amply, and a meal could be served to all the quads at one "sitting." Goofy was forced to recline as shown. Each cub had its own feeding station. The runt stood on her arm.

While feeding, black bear cubs hum and sing a contented song, which starts softly and gains volume as stomachs fill. The song, like the buzzing of a swarm of bees, has more than once led the author to the scene of photographic possibilities.

When Goofy tired of the camera, she rolled over and stood on her feet without so much as a warning grunt. Cubs fell like leaves in autumn, and Goofy marched toward the photographer, clearly showing that she meant business. Doctor Kinney withdrew, but he had secured the only pictures ever taken of a mother bear nursing four cubs

(Below) WITH STOMACHS FULL, the quads drop off to sleep. But Mother stays on guard as long as they are on the ground

GEM FOR OCTOBER

October's child may treasure an imprisoned rainbow, or choose from many harmonious colors offered by the sturdy tourmaline

By FREDERICK H. POUGH
Acting Curator, Geology and Mineralogy, The American Museum of Natural History

THE strongest, most harmful, and least sensible of all gem traditions is probably the most modern in origin. When Sir Walter Scott dressed his mystic Lady Hermione with an opal in her hair, in *Anne of Geierstein,* he did that most beautiful and individual of gems a disservice from which it has never recovered. Because Lady Hermione came to what appeared to be an unhappy end, the superstition has arisen, and seems to be believed by many otherwise normal people, that opals bring bad luck. Probably nothing could have been further from Scott's mind, but apparently there is no other explanation for the modern superstition.

In the Middle Ages opals were believed to be valuable in treatment of the eyes. Opals were associated with thieves, because they were thought to have the power of making their wearers invisible. Blond girls wore them to preserve the coloring of their hair. Fairly abundant in the Middle Ages, these delicately tinted stones were known to many since they had a European origin. Unlike most of the early gems they came, not from the far away Orient, but from near by, in Czernowitz, Hungary. They are fragile, however, and it is possible that the modern superstition arose in part from their susceptibility to fracture.

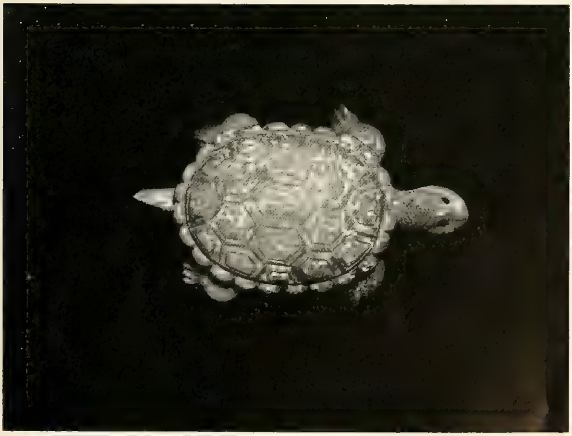
Opals have the most brilliant and wonderful coloring of all the gems,—the fire of the ruby, the cool greens of the emerald, and the rich blues of the sapphire. Yet this gem owes its color to no impurity; no trace of another element adds to its charm. Opal is composed of pure silica and water; chemically it is much like quartz, except for additional water and the fact that it is not crystallized. Its beauty can be attributed to that very fact, for in place of the regularly distributed and fixed proportions of silicon and oxygen of the quartz, we have a sort of solidified gel, composed of layer after layer of slightly varying proportions of water and silica.

No certain explanation of the color play of opal has been given. Once it was thought that the layers were separated by microscopic cracks which broke up the reflected light rays. For we know that the color does not lie in the stone itself, but arises from a separation of the infinite number of differently colored rays that make white light. Light transmitted *through* an opal shows its true color to be gray or orange, or it may be colorless. Other theories of this interesting color play agree that the microscopic cracks developed but suggest that more opal material, which bent light slightly differently, later filled in the spaces. Some scientists think that the superimposed layers simply break up the light, without requiring filled or unfilled fractures in the stone. Still another suggestion holds that precious opal formed as a replacement of some other mineral and that some of the crystal direction lines of the original mineral are preserved in the opal, producing its fire. But no one knows. Science is still baffled by this unique gem.

All opal—a common mineral—does not have the fire of the precious opal. Sometimes it is drab yellow, white, brown, or colorless. Often it replaces wood or shells, forming fossils of precious opal, which are found in Nevada and in Australia. Another variety of opal, known as fire opal, has little or no internal color play, but it does have a rich orange color. Because opal is a gel containing water, it may dry out, contract, and crack in the dry air of our heated homes. Since it also is not hard, opal jewelry should be treated with care.

A realistically carved turtle, in opal from Australia

AMNH photo



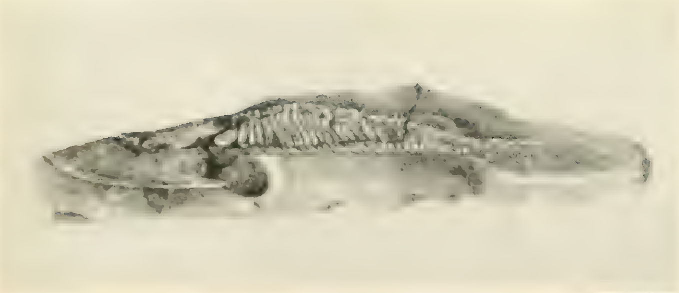
Pliny tells a story of a Roman senator, Nonius, who had an opal which Antony desired. Because he would not give it up, he was banished from Rome and his possessions forfeited—but he kept his ring. Modern mineralogists do not think it was the same stone as that which we today call opal. What it may have been has not been guessed. Though adversity came to Nonius, he could not have thought the opal unlucky to have sacrificed so much to retain it.

Photo by B. M. Shaub

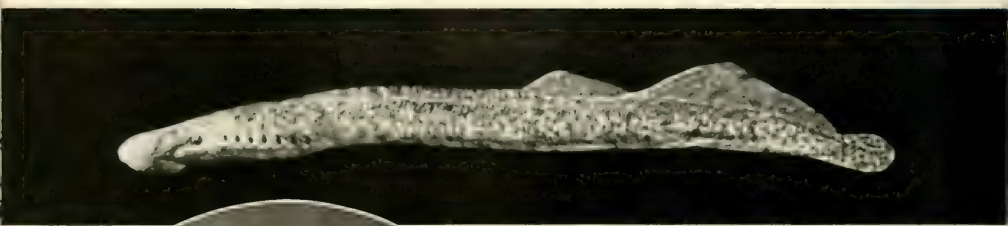
A tourmaline crystal, with quartz, from Pala, California

An alternative and sturdier stone, the tourmaline, has been accepted by jewelers for this month as well. This is an attractive mineral which comes in many colors, and a single crystal often shows more than one hue. A variety with a green skin and a pink center is known appropriately as watermelon tourmaline; but other tourmaline crystals change color along their length instead of outwards from the center. The gem is a complex silicate of boron. Found in many places where the rocks are old—in once deeply buried formations that now reach the light—tourmaline, like beryl and topaz, forms in rocks which once were molten, deep below the surface. The best stones today come from Brazil, where most of the crystals are green; others are found in Madagascar, South Africa, Maine, and California, in almost every color and shade.

Those born in October who want some particular color in a birthstone can often find it in the tourmaline; but should they desire every color at once, a tangible rainbow, then only opal can please them.



(Left) "GRANDFATHER" of 50,000 species of living animals and countless extinct ones: the 400 million-year-old "shell-skinned" fish, Cephalaspis. Its ground plan is seen to develop through successive evolutionary stages to provide the complex bodily features of all the modern fishes, amphibians, reptiles, birds, and mammals



(Above) ANOTHER LIVING FOSSIL descended from Grandfather Fish: the lamprey, front and side. Its efficient suction disk has permitted the lamprey to survive down to the present day in spite of its refusal to adopt a modern body design. Lampreys are sometimes popularly called eels, but in the tree of life they are farther from eels than eels are from man

Twenty-four centuries ago, the Greek philosopher Anaximander said that men were first produced in fishes and when able to help themselves were thrown up to live upon

GRANDFA

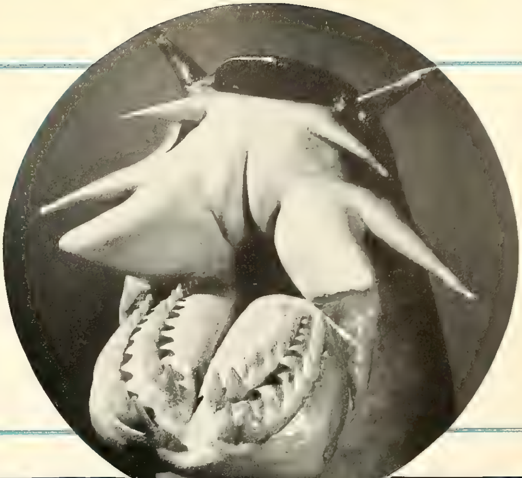
By WILLIAM K. GREGORY

[illegible]

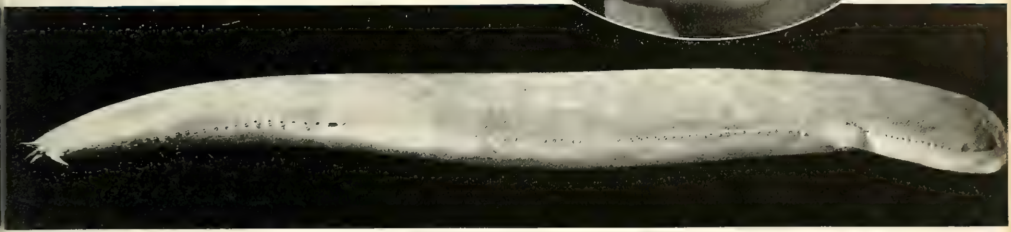
GRANDFATHER FISH lived so long ago that his personal history might seem to be of small importance to his remote descendants. Very few of them have ever heard of him anyway, and if they did they would promptly disown him. The very idea that man has been derived from a fish might seem to them even more fantastic than that man's ancestor was a monkey.

In this article we are not attempting to set forth the evidence for the reality of Grandfather Fish, for that evidence is scattered among thousands of facts and recorded in hundreds of books and papers. Neither are we assuming momentarily an improbability merely to lead to something better. We are only trying to sketch the introduction to a factual history covering several hundred million years in the transformation "from fish to man."

(Right) A VAMPIRE of the sea with an illustrious lineage. The modern hagfish is a "die-hard" that retained many of Grandfather Fish's basic features and survives today as a veritable living fossil. It lacks the true jaws of modern fishes and uses outmoded pouch-like gills. In place of a backbone, it has an elastic notochord. But it has developed a full kit of burglar tools for rasping a hole in the body of a fish and sucking out its blood. The portrait shown is from a model on display in the American Museum of Natural History. Directly below is a side view of the same creature



All photos by AMNH



the land. Modern science, piecing together the factual story, finds that this ancient theory was surprisingly farsighted. Here the celebrated author of *Our Face from Fish to Man* tells the first chapter in the evolution of backboned animals. Other chapters on the history of animal life in North America by various authors will appear in future issues

THER FISH and his descendants

Before we begin that history we must glance for a moment at its sources and documents. Broadly speaking these are: (1) paleontology, or the science of ancient life; (2) living animals, their zoology, embryology, and comparative anatomy, and (3) such newer sciences as experimental biology.

As to the documents of evolution, confusion has sometimes come from the very wealth of the evidence. There are estimated to be over 50,000 known species of backboned animals still existing, and if the known fossils are added, the number becomes even more bewildering. But there are easily available clues to this labyrinth.

Every beginning student in zoology is taught the rudiments of the classification of animals. He is expected to know that the smaller divisions, such as varieties, subspecies, and species, are combined in an ascending scale into larger groups called genera, and that these in turn are built up into progressively wider and more comprehensive assemblages called families, orders, classes, superclasses, and phyla. But what the student may not realize is that any individual cat, for example, besides being a sample of the species, also has the physical characteristics common to all members of the cat *family,* and, in decreasing numbers, those of the *order* of carnivores, of the *class* of mammals, and of the *phylum* of vertebrates. As a rule the popular mind as recorded in common speech thinks of one thing at a time and has a special name for it: cat, dog, bear, skunk, etc. And among specialists the idea has gained credence that the most important kind of knowledge is that which expresses the finer differences between different varieties of the same general kind. But when we study individual animals as representatives of larger groups, we find that the characteristics common to a broad division of animals, such as a class, are mostly older in the evolutionary story than those of the smaller division known as the family, and that the latter are in turn older than those of the genus, and so on down to individual peculiarities. This is like saying that the human race as a whole has had two arms and two [illegible] hunters show that the same principle holds true in [illegible]

Thus the classification of living animals into broad [illegible] as to which characteristics are older and which are [illegible] animals, especially when used in connection with the fossil remains of the animals themselves.

[illegible] NATURAL HISTORY [illegible] Grandfather Fish [illegible] evolution. This chart will be found useful in connection with other articles that will appear in NATURAL HISTORY dealing with other chapters in the story of the origin of our animal life in North America. Here only 81 animals have been selected from the thousands that have made their appearance along the stream of time, but these few samples represent most of the main divisions of animals concerned.

The broader lines of descent and relationship are shown on the chart by the main branches and by the larger lettering. How have we discovered these lines? They are [illegible] most unexpected by-products of the exploration of hundreds of localities yielding fossils in many parts of the world. Nobody, for example, dug fossils anywhere with the purpose of proving that the most ancient and primitive fishes were the ones known as the ostracoderms, or "shell skins." Indeed, these shell-skinned forerunners of the true fishes were long thought to be "specialized and extinct side branches" of the supposedly unknown ancestral stock of the vertebrates. But, thanks chiefly to the later explorations of the Danish East Greenland Expedition, and to the intensive work of Doctor Stensiö of Stockholm, it is coming to be realized that the ostracoderms as a whole have the basic requirements for this key position in evolution. This means that we may properly search among them for Grandfather Fish,—the type of fish that is responsible for all the hosts of backboned animals that today inhabit the land and waters. With regard to the many intervening types of vertebrates, whether or not we know their *exact* ancestors and descendants in each case, we are getting better and better evidence of what led up to them and where they belong in the general sequence of events.

Finally, we have certain animals on earth today that are conservative "die-hards,"—"living fossils" which have lagged behind their progressive relatives and retained for our inspection much of the internal ground plan of their remote ancestors. Among living creatures, the lampreys (often wrongly called eels) preserve the basic features of the ostracoderms. For example, they have no true jaws of the complex type presently to be described, and their gills are pouch-like. Also they have a large elastic rod along the back, known as the notochord, which all backboned animals possess before birth but discard for the more rigid and serviceable backbone. Therefore, though the lampreys are millions of years removed from Grandfather Fish, they are classed with him and the ostracoderms, under the superclass Agnatha (jawless).

Grandfather Fish seems to have fed on small living things, probably by sucking them into the mouth slit by a pumping action of the throat. But his descendants, the lampreys and hagfishes, attack other fishes, hanging on by a horny sucker that is armed with sharp thorns, and rasping the flesh of their victims with their thorn-studded tongue.

While the earlier ostracoderms fed on small creatures or floating organic particles, all their principal descendants later attained a predatory or robber stage. Some never got further, others pushed on to become quiet vegetarians. Jaws, it may be noted, were primarily organs for seizing and biting living prey, and all the backboned animals above the ostracoderms and lampreys are frequently grouped together into a superclass called "gnathostomes," or jaw-bearing vertebrates. In spite of this classification, at least some ostracoderms (for example, Pteraspis) had a jaw-like bone in the lower margin of the mouth and a firm palate against which it could work.

In these shell-skinned ostracoderms the head and forward part of the body were usually covered with a shelly case. How did this condition come about? The physiologist Homer Smith has put forward an ingenious and highly plausible theory, as follows. When the still more remote and as yet undiscovered vertebrates came up out of the sea into the rivers and lakes, their blood, or body fluid, which was nearly as salty as the ocean itself, would tend to absorb the fresh water through the then naked or porous skin. Since fresh water tends to pass through a permeable membrane at a greater pressure than that of the saline blood, the fresh water would continue to be absorbed until a state of dropsical swelling would result. The proper balance for the animal was restored when its kidney tubules began to secrete an excess of calcium salts. These, being carried by the blood stream and deposited in the skin, eventually formed a waterproof armor of surface plates. Hence the building up of bumps and spikes on the surface plates, formerly regarded as a fatal specialization, seems to have been merely a stage in the evolution [illegible]

The Chart

GRANDFATHER FISH AND HIS DESCENDANTS

The following is a detailed explanation of the most important groups of animals shown on the chart on the next spread. This chart outlines the evolutionary road from fish to man, as developed by Dr. William K. Gregory.

Since the period covered is about 400 million years, only the most significant steps can obviously be shown. During this long period, whole groups of animals died out without leaving any descendants to carry on their line. Other large divisions, on the other hand, continued in greater or less abundance to give us the estimated 50,000 different species of backboned animals that we have on earth today.

The chart will be found useful also in connection with succeeding chapters on the history of animal life in North America that are to appear in NATURAL HISTORY Magazine.

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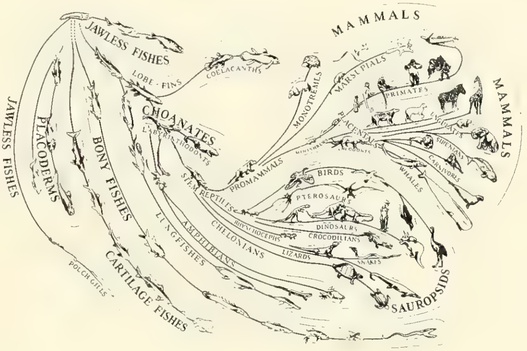

JAWLESS FISHES (Agnatha). These are the oldest and most primitive known chordates, or animals with a notochord or core of the backbone. The group includes the ostracoderms (shell skins) of the Silurian and Devonian ages and their pouch-gilled modern descendants, the lampreys and hagfishes. The casts of the internal structure of the head of ostracoderms reveal paired organs for smelling, seeing, and balancing. These collectively are included in the "basic patents" for the control system of all higher vertebrates, including man. The ostracoderms, although diversified in body, also show the beginnings of median and paired fins, and their motor units, as in higher vertebrates, are the red muscle fibers.

PLACODERMS. This large group was basally intermediate between the "jawless" and the "jawed" vertebrates. It showed an early stage in the formation of complex "gill-arch jaws" plus tooth-bearing jaw plates. The higher placoderms included the curious "joint-necks," an extinct group, mainly gigantic predators.

CARTILAGE FISHES. Sharks, rays, and their fossil relatives and ancestors are included in this group. Its members are generally primitive in their jaws, teeth, and internal organs, but the gristly state of their skeleton is now believed to be due to the retention in the adult of an embryonic condition. The sharks possess greatly developed smelling organs, while in the bony fishes *(see below)* the sense of vision is predominant.

BONY FISHES. These in the broader sense include the vast majority of still existing fishes. In the earlier forms, called ganoids, the massive scales had a thick bony base and were covered with a shiny layer of ganoin. In the modernized bony fishes, or teleosts, the scales have lost the bony plate and the ganoin, and have become thin and horny. The teleosts display the utmost diversity in body form, fins, jaws, teeth, food, and breeding habits. They are very far removed in structure and in time from the stock which gave rise to the land-living vertebrates.

CHOANATES. These include the air-breathing fishes with internal nostrils, including the lungfishes, the lobe-fins, and the ancestors of all the four-footed land-living animals, scientifically known as tetrapods. The chief divisions are:

Lungfishes. These form a side branch appearing in the Devonian and continuing up through all the ages into the existing Australian, African, and South American lungfishes. On the roof of the mouth they have a pair of dental grinding plates like two fans arranged back to back, which work against similar plates on the inner sides of the lower jaw. Their paired paddles are elongate, leaf-shaped to thread-like.

Lobe-fins (Crossopts, Rhipidists). These are the central stock of the air-breathing fishes. They have strong dagger-like cutting teeth fixed to the jaws with greatly infolded (labyrinthine) bases. The group is characterized by paired paddles which are strong and fan-like but have a tapering jointed axis.

Labyrinthodonts. These are the first of the four-footed land animals (tetrapods). Their teeth are infolded at the base as in the lobe-fins, and the skull also is similar, though it lacks the opercular bones covering the gill chamber. The paired appendages, however, have become typically five-rayed, essentially as in all higher vertebrates. The shoulder girdle is not tied to the skull. The pelvis is subdivided into three bones on each side.

Amphibians (modern). In this group are the salamanders, newts, sirens, frogs, toads, and the worm-like caecilians. Their young are hatched from eggs spawned in the water or developed in a watery medium enclosed in a leafy covering. The "tadpoles" usually have fish-like gill arches and external gills. During metamorphosis, legs sprout from within the body, and the adult animal may become either fully land-living or secondarily water-living.

SAUROPSIDS. This vast assemblage includes all the diverse reptilian hosts, together with the birds. The extinct stem reptiles (cotylosaurs) grade back almost

GRANDFATHER FISH and his descendants

By WILLIAM K. GREGORY

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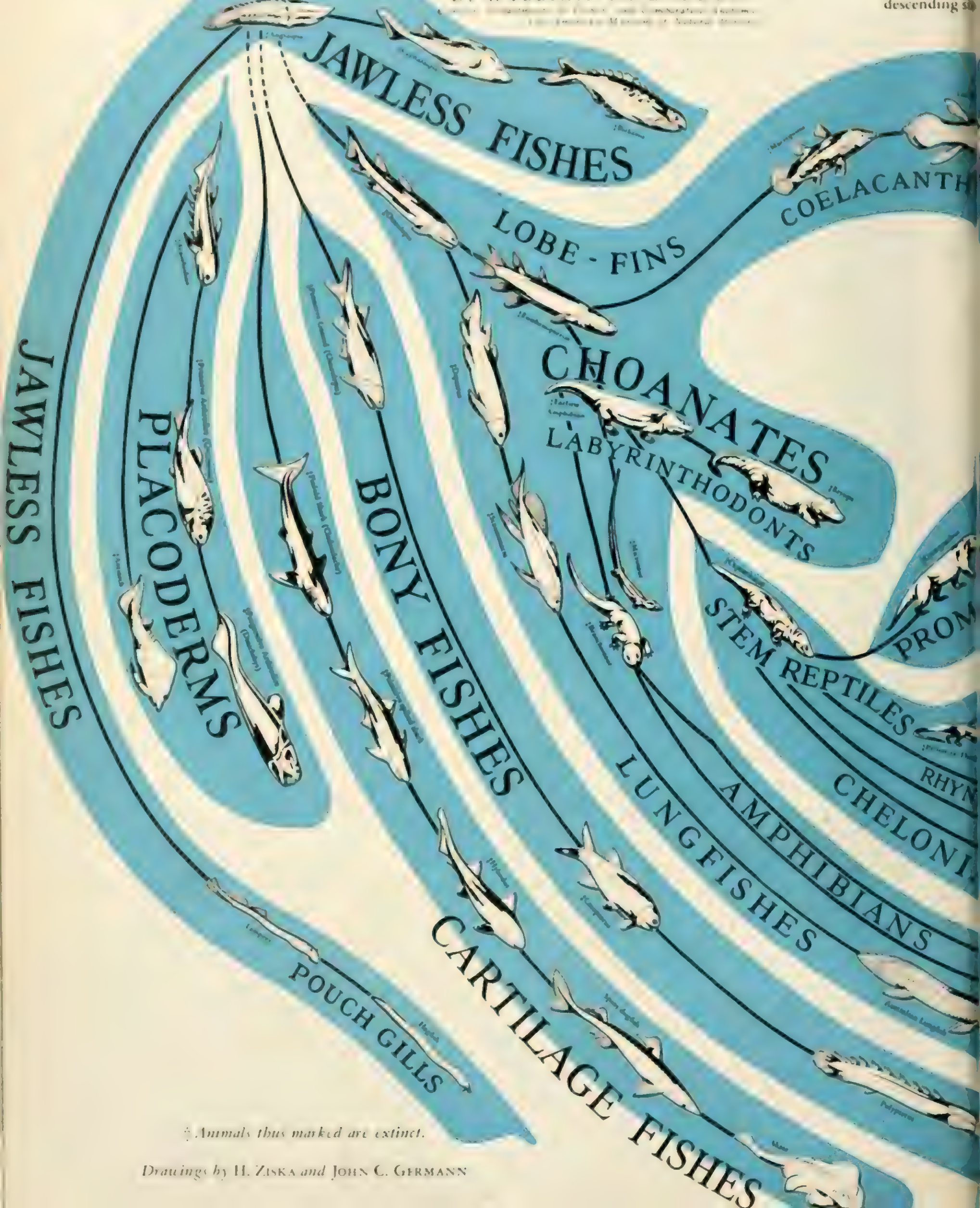
JAWLESS FISHES
LOBE-FINS
COELACANTH
CHOANATES
LABYRINTHODONTS
STEM REPTILES
PROM
RHYN
CHELONI
AMPHIBIANS
LUNGFISHES
BONY FISHES
PLACODERMS
JAWLESS FISHES
POUCH GILLS
CARTILAGE FISHES

† *Animals thus marked are extinct.*

Drawings by H. ZISKA *and* JOHN C. GERMANN

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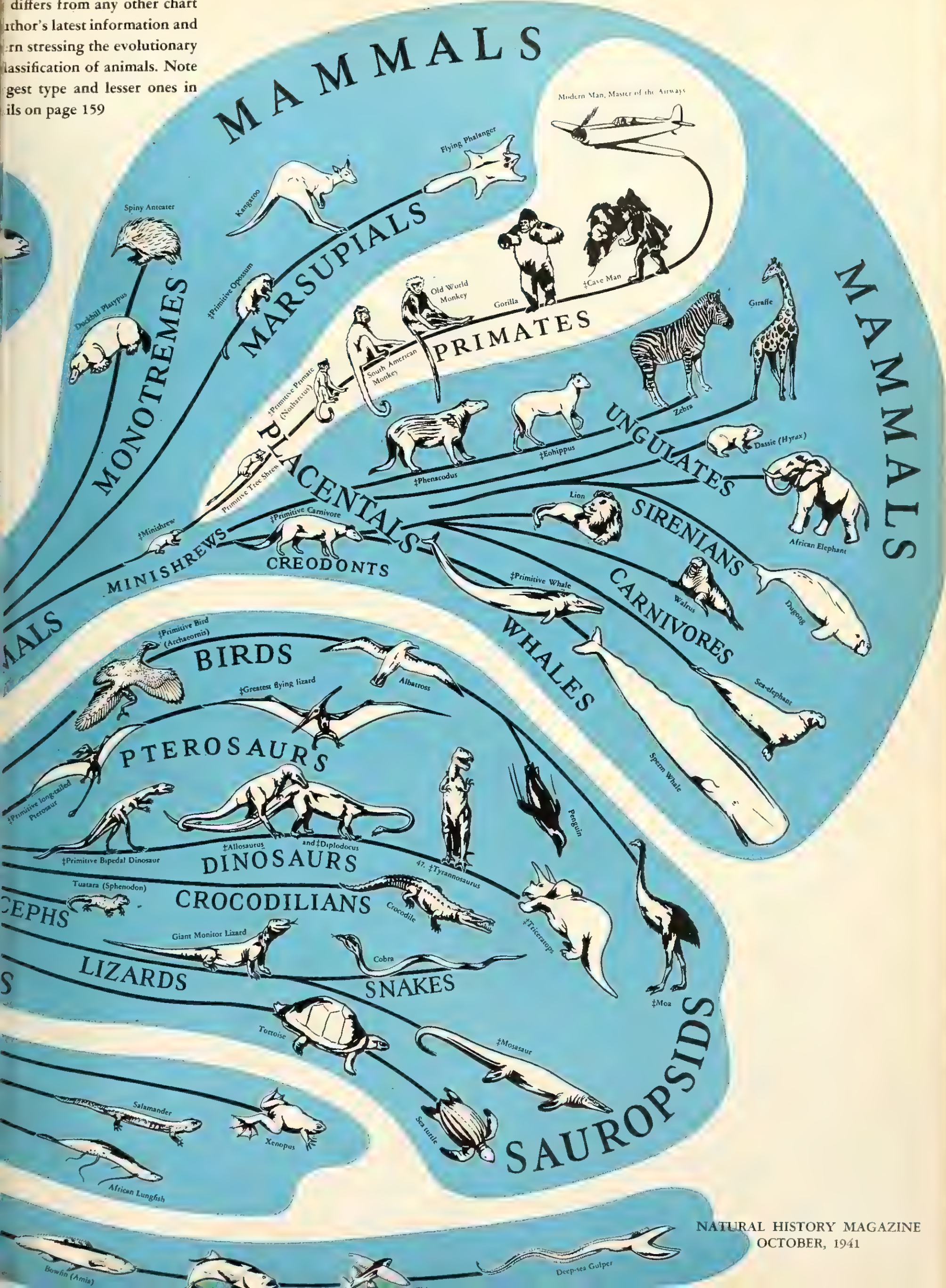


MAMMALS
Modern Man, Master of the Airways
Flying Phalanger
Kangaroo
Spiny Anteater
Duckbill Platypus
MONOTREMES
‡Primitive Opossum
MARSUPIALS
Old World Monkey
Gorilla
‡Cave Man
South American Monkey
PRIMATES
‡Primitive Primate (Notharctus)
Primitive Tree Shrew
PLACENTALS
Giraffe
Zebra
MAMMALS
‡Phenacodus
‡Eohippus
UNGULATES
Dassie (Hyrax)
African Elephant
Lion
SIRENIANS
‡Minishrew
MINISHREWS
‡Primitive Carnivore
CREODONTS
‡Primitive Whale
CARNIVORES
Walrus
Dugong
WHALES
Sea-elephant
Sperm Whale
MALS
‡Primitive Bird (Archaeornis)
BIRDS
Albatross
‡Greatest flying lizard
PTEROSAURS
‡Primitive long-tailed Pterosaur
Penguin
‡Primitive Bipedal Dinosaur
‡Allosaurus
and ‡Diplodocus
47. ‡Tyrannosaurus
DINOSAURS
Tuatara (Sphenodon)
CEPHS
CROCODILIANS
Crocodile
‡Triceratops
‡Moa
Giant Monitor Lizard
Cobra
LIZARDS
SNAKES
S
Tortoise
‡Mosasaur
SAUROPSIDS
Salamander
Xenopus
Sea turtle
African Lungfish
Bowfin (Amia)
Deep-sea Gulper

NATURAL HISTORY MAGAZINE
OCTOBER, 1941

until the [illegible] and forward [illegible] of the more typical [illegible]. In [illegible] the first reptiles represent a marked advance beyond the labyrinthodonts. They have [illegible] the fish [illegible] stage, and the eggs may be hatched on the land or hatched within the body of the parent. Besides [illegible] maintaining a more stable body temperature [illegible] are [illegible] but poorly developed in the lower reptiles.

The main divisions of this group are as follows:

Chelonians. These are the turtles and their allies. They are the oldest branch of the stem reptiles. They have performed the amazing anatomical feat of developing a bony dorsal outer skeleton and at the same time drawing the top of their shoulder girdle well beneath the projecting rim of the first ribs. In the sea turtles the large forefeet have been changed into wing-like paddles.

Lizards. Though not far removed from the stem reptiles, the lizards have developed a skull in which the surface bones, especially those that originally covered the jaw muscles, have dwindled into narrow strips and bars.

Snakes. **These are essentially lizards that have lost their limbs and acquired huge, loosely attached jaws for swallowing large prey. The extinct marine lizards (mosasaurs) were closely related to the existing monitors.**

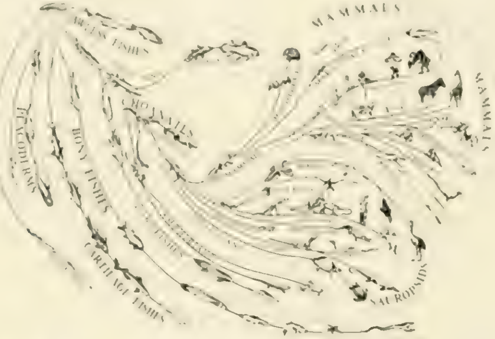
Rhynchocephalians. These are represented today only by the tuatara of New Zealand. **They were an early side branch equipped with somewhat rat-like front teeth, and are related to the lizards on one hand and to the stem of the dinosaurs on the other.**

Thecodonts. These were slender fast-**running, lizard-like reptiles of the Age of Reptiles, with many skeletal features that foreshadowed the ancestors of the crocodilians, dinosaurs, and other extinct** groups.

Crocodilians. Now reduced to a few sur**vivors (crocodiles, alligators, gavials), these were once a highly diversified group. They were an aquatic side branch from** the ancient forebears of the dinosaurs. Many features of the skeleton are like those of dinosaurs, but others are highly peculiar. Their skull and jaws form an exceedingly efficient apparatus for capturing fish and even large mammals.

Pterosaurs, or flying reptiles. In these animals the enormously enlarged fourth finger of each hand served as a movable framework for a wing membrane. These reptiles, although excessively specialized, were a side branch of the thecodont group mentioned above.

Birds. These are truly glorified reptiles. The strong, greatly improved four-cham**bered heart and the presence of feathers** and air sacs enables a high body tempera**ture to be developed and maintained with**in wide limits.



PROMAMMALS, or mammal-like reptiles. The earliest of this series were small, lizard-like offshoots of the stem reptiles, **but as we follow the history of the group, many of them became swift-running creatures, and some gradually approached the** earlier mammals in the details of their **skeleton. For example, the teeth in *Cynognathus* and related forms became differ**entiated into incisors, canines, premolars, and molars, all adapted for a flesh-eating **diet and thus foreshadowing the central** group of mammals. At the rear end of the **skull the joint with the first or atlas verte**bra of the neck was formed by a double **ball-and-socket, as in the mammals. A bony palate of mammalian type was being formed, and the limb bones were becoming fitted for swift running.**

MAMMALS. In general the mammals are characterized not so much by the fact that they "bring forth their young alive" (because certain sharks, lizards, snakes, and ichthyosaurs also follow this method), but because the newborn are fed with milk from the mother's breast. Among the mammals are the following:

Monotremes. **These interesting animals (including the duckbill platypus and the spiny anteater) differ from other mammals in that their eggs are not developed into young inside the body of the parent but are laid, like those of reptiles. Also the breasts are represented only by milk-secreting depressions on the ventral surface of** the body. But the skin is well provided with hair as in mammals. The popular statement that the duckbill is a link between birds and mammals is entirely in error.

Although the oldest known mammals date from the upper Triassic period (about 165 million years ago), fossil remains of this group are for the most part exceed**ingly rare during the greater part of the** Age of Reptiles. The most conspicuous **examples are the numerous and diverse fos**sil jaws of very small mammals, ranging from the size of those of a mouse to those of a kitten, which have been found in rocks of the Jurassic period near Oxford, England and in Wyoming, United States.

Marsupials. Near the close of the Reign **of the Dinosaurs, another glimpse of early mammalian history is afforded by discovery of a lower jaw and parts of a skull associated with the bones of a dinosaur. These represent a primitive opossum, the forerunner of the great marsupial division of the mammals, in which the young are born in a very immature condition and are subsequently nursed in the mother's pouch.**

Placentals. **All the higher mammals, including carnivores, herbivores, primates, and whales, belong to this division, in which the unborn young float in the in**terior of a membranous bag. A part of the **bag, called the placenta, is in contact with the inner wall of the mother's womb. Although the blood of the mother does not pass directly through the placenta, this absorbent organ is able both to select from the mother's blood nutritive material for the growing fetus and to excrete waste products from the latter into the maternal blood stream. Partly by means of this improved method of producing high-grade young, the placentals have become the dominant group of mammals in the present epoch of earth history.**

The oldest known placentals are represented by a few very small fossil skulls and jaws found in the Upper Cretaceous rocks of Mongolia. Among these are some whose teeth, jaws, and skull appear to embody the fundamental features for the rise of all the diversified insectivores, carnivores, and derived groups of the Age of Mammals.

of the outer or dermal skeleton. And, especially among the later or true fishes, there is much evidence that teeth arose from little swellings or spikes on the surface plates of the mouth and gill region.

To make effective use of its jaws and teeth, an animal must usually be able to pursue its prey. Hence all predators, at least of the vertebrate type, have a complicated system of locomotor organs, the power of which is furnished by the red muscle fibers. The beginning of contractile tissue is suggested in the jellyfishes, in which the mouth and body wall already exhibit sensitivity and contractility, which are the basis of the nerve-muscle complex. But by the time of the ostracoderms the vertebrate stock had already reached the stage in which the muscle fibers were strung in parallel series along the sides of the body. These were separated by partitions into more or less **W**- or **V**-shaped strips, called myomeres. A long series of these muscular segments was arranged on each side of the elastic notochord. But the real secret of vertebrate locomotion is found in the crossing over of certain nerve fibers from one side of the spinal cord to the other. This arrangement starts a wave of contraction that runs down along one side of the body, while almost immediately afterward another wave is started on the opposite side. In this way, the primitive vertebrate, although by no means flag-like in shape, could "wave" its way along the bottom or weave through mud, and was eventually able to swim freely in pursuit or flight.

The ostracoderms when we first find them had already attained a considerable diversity of body form, as shown in the accompanying illustrations. Broadly speaking, the most primitive form was shaped somewhat like a flattened raindrop, while one or more specialized side branches were much flattened, like a skate, and another was narrow and tending to be ribbon-like *(Pterolepis)*. In the typical cephalaspid ostracoderms the head shield was almost semicircular in outline, domed toward the center. The eyes were on top and looked like a pair of spectacles. Presumably these creatures clung to the surface of rocks or moved slowly along on the bottom. In *Birkenia,* which appears to be related to the cephalaspid stock, the body was becoming quite fish-like with the small head streamlined into it.

The interior of the head of the more primitive ostracoderms was comparatively simple in plan. There were three right and left pairs of organs for smell, sight, and the balancing sense, arranged one behind another on each side of the middle. Between them was the brain, doubtless showing corresponding subdivisions, and behind them the medulla and spinal cord. Below the brain and main sense organs was the roof of the chamber into which the mouth and gills opened. Thus we see that this lowly ostracoderm had already achieved the general pattern and arrangement of a number of important organs that have been retained in all later backboned animals, including man.

When some of the ostracoderms died, the mud seeped into the blood vessels of the head shield and followed the tunnels in the skeletal tissue left by the cranial nerves. Thus when the entire mass was turned into rock, there was a permanent record of the blood vessels and nerve tunnels. Stensiö found that he could safely identify most of these vessels and nerves by careful comparisons with the similar parts in the existing lampreys.

As already mentioned, the initial step toward the development of complex jaws had been taken by Grandfather Fish, himself, who was already using some of the upper and lower plates around the mouth as tweezers or pincers. The next great advance is seen in the Devonian period (about 300 million years ago), when certain fishes (placoderms) began to enlarge the first of the internal skeletal hoops supporting their gills, as bases for the surface jaw plates.

From the placoderm stock the foregoing "basic patent" for complex jaws was transmitted with increasing modification in detail to the cartilage fishes, bony fishes, lungfishes, stem amphibians, and higher vertebrates. Unmistakable remnants of this arrangement may be seen in the jaws and throat of the embryos of existing fishes and higher vertebrates, including man.

The ostracoderms and placoderms also show very significant experiments in the formation of paired locomotor appendages. Even in some of the ostracoderms the sides of the body just behind the head shield were prolonged into rounded lobes or projections of the body wall, which presumably were more or less movable and served somewhat like the lateral stabilizers of an airplane. When, as noted above, the kidneys secreted an excess of mineral matter, it often accumulated on the surface in the form of spikes located along the back or on the sides of the body. Behind the spikes the skin was pulled up into a sort of fin or web. These backwardly curved spikes, like the other projections, served as stabilizers in keeping the fish on its course.

Later the **W**- or **V**-shaped muscle segments of the body began to attach themselves to the underside of the spikes and fin webs. From this it was but a short step to a stage in which the spikes could be raised or lowered, thus greatly improving the fish's ability to make quick turns. This took place in a group of placoderm fishes known as the acanthodians. The earliest ones retained widely based spikes, but

[illegible]

A [illegible] these [illegible] the [illegible] were [illegible] in their [illegible] attack. They [illegible] to the Devonian "joint-necks," scientifically known as arthrodires. They received their name from a [illegible] socket joint on either side between the head shield and the shoulder plates. When they were about to attack they [illegible] raised the head and opened the mouth very wide. The front "teeth" on the larger arthrodires were somewhat like a parrot's beak. Behind the beak were shearing plates, like butcher's knives. Dr. Bashford Dean, the American Museum's first Curator of Ichthyology, with a humorous touch of understatement, said that the arthrodires were "doubtless unpleasant neighbors," especially to the fin-fold sharks (Cladoselache), which he himself made famous in zoology textbooks.

Thus most of Grandfather Fish's early relatives had the advantage of some sort of armor. As they became more formidably equipped with offensive weapons, however, and developed the ability to move rapidly, this armor was for the most part reduced or eliminated.

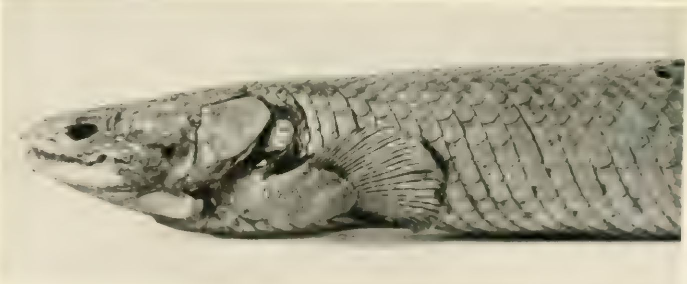
The story of the rise and diversification of the swarming lines of bony fishes (ganoids and teleosts) is demonstrated by thousands of fossil and recent forms. But here we must be content to say that the earliest bony fishes had bodies completely encased in an armor of thick scales with a bony under layer and a shiny surface of enamel (whence our name ganoid for these fishes, from the Greek *ganos,* shiny). The horny scales of modernized fishes are a later development.

[illegible] traces the jaws and feeding habits of the bony fishes that descended from him, because they became exceedingly diversified. From a primitive stage in which the upper jaw was fixed, one can trace the changes into highly protrusile sucking jaws, jaws armed with sharp-edged sabers, massive jaws with crushing teeth, tube-like jaws with little nippers at the tip, etc. It is hardly necessary to state that the modern fishes as a whole have become very far removed from the earlier lines that gave rise to those backboned animals which established themselves on land.

The modern sharks used to be regarded as paragons of primitiveness, but it is now coming to be realized that the gristly or cartilaginous base of their skeletons may instead be only a hold-over of a normally embryonic feature into the adult stages of life. In the cartilage fishes the pectoral fins range from slightly movable, wide-based keel fins acting as elevators and depressors in swimming, to flexible paddles with a narrow wrist-like base. As the muscles in the fin bud grew upward and subdivided into a fan-like cluster, so did the bony rods that supported them. Thus were produced large fan-like fins as in the skates, in which the individual rods could be moved in sequence like the keys of a piano.

As long as fish remained fish, their opportunities for invading the land were quite limited; and only a few forms of present-day fishes venture to risk the traditional fate of a "fish out of water." This undertaking was successfully achieved some 300 million years ago, however, in one of the most dramatic and far-reaching events in the whole history of life. The modern fishes which temporarily manage to live on land include the famous mudskipper, the tree-climb-

PROTECTION is afforded our surviving ganoid fishes, like those of the past, by their hard, enamel scales *(below)*. Most modern fishes, on developing offensive weapons and rapid movement, adopted more delicate ones. This is the famous *Polypterus* of Africa



ing fish *(Anabas)*, and certain eels and eel-like fishes. Suffocation in air has been avoided either by developing an accessory enclosed gill chamber with a supply of oxygenated water, as in the labyrinth fishes, or by the further development of the lungs. These were the birthright alike of the lungfishes and the lobe-fins.

The early lungfishes were well equipped to burrow in mud and thus survive seasonal droughts, as their descendants still do in central Africa. But they never developed strong limb-like paddles, and in the later lungfishes the paddles have been reduced to long threads. In our search for the forerunner of the first land animals, the evidence leads up to the air-breathing lobe-fins; for they alone have the right combination of characteristics to give rise to the severally distinctive patterns of skull and skeleton found in the earliest amphibians.

We are speaking of very remote time, but even so, we of today have a link with that distant era before the backboned animals came out onto the land. A very specialized side branch from the lobe-fins were the coelacanths. The last of the coelacanths, it was formerly thought, perished with the dinosaurs at the close of the Cretaceous period. But in 1938 some fishermen who were trawling off East London, South Africa, hauled in a strange-looking five-foot fish. After careful study by Dr. J. L. B. Smith, this was proved to be the only known living descendant of the coelacanths.*

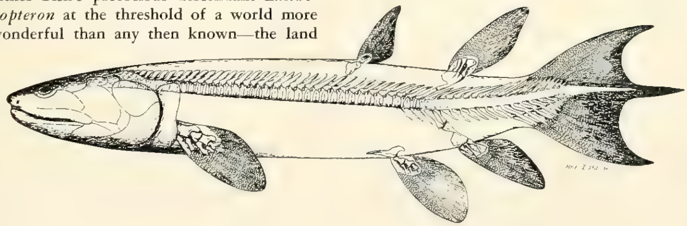
The oldest lobe-fins of the mid-Devonian had pectoral fins of the fringe-finned (crossopt) type with a jointed axis and delicate side rods; but the more advanced Upper Devonian fish known as *Eusthenopteron* had broad, spreading pectoral fins, supported by a strong skeleton *(see drawing)*.

But exactly *how*, the reader may well ask, were the flexible paddles of the air-breathing lobe-fins able to bear the weight of the body on land, which eventually became perhaps their foremost duty? After several years' study of the fossil and anatomical evidence, my colleague, Henry C. Raven and I have ventured to put forward the following partly new theory. As the paddle became bent at the future elbow and wrist joints, its bones gave rise directly to the three arm bones—humerus, radius, and ulna—and to the central carpal bones of the hand. The bones corresponding to the ones farther out on our hands, on the contrary, seem to have come from new buds from the rear border of the original paddle bones, as indicated in the individual development of the living newts and salamanders. The horny rays of the fin must have diminished and finally disappeared, as they did in the lungfishes. Meanwhile the muscular lobe of the paddle grew outward and subdivided into the muscles of the hand. The rear paddle became modified in much the same way.

Thus *Eusthenopteron* stood almost at the threshold of a far greater and more diverse world than any that he or any other water creature had ever known. For when his descendants began to push their frog-like snouts up on to the river banks, our ancestors were taking the initial step toward the conquest of all the lands.

[The epic story of the rise and evolution of our four-footed, land-living animals will be told in successive issues of NATURAL HISTORY.—ED.]

PADDLE-LIKE FINS for "walking" on mud and the ability to gulp air occasionally put Grandfather Fish's precocious descendant *Eusthenopteron* at the threshold of a world more wonderful than any then known—the land



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*See Edwin H. Colbert, *"A Fossil Comes to Life,"* NATURAL HISTORY, *May, 1939, p. 280.*

NO WONDER THEY

By Margaret Lantis*

[illegible]

From Alaska to Greenland and Labrador, over a range longer than from Oregon to Maine and Florida, the Arctic coast is inhabited by "the eaters of raw meat"—the Eskimos. They might reasonably be referred to as the eaters of raw seal, for without this animal, most of the Eskimos would have to leave their homeland or die. Not only do they depend on the seal to a vital degree for food but for important items of clothing and innumerable implements—indeed, for almost every imaginable necessity from boats to "windowpanes."

Some Eskimos rely more upon the seal than those of Nunivak Island, some less. This community is portrayed here because it shows many of the characteristic ways in which the natives of the North weave their lives inseparably with the seal.

Where there are more seals you are likely to find more people, and here you have the town of "More People," Mekogoyuk in the native tongue, where the author lived for eleven months in 1939-1940. The dwellings are not snow igloos, for the Alaskan Eskimos have never seen them in their region. They are the half-underground log and sod houses, to which the isolated Nunivak Islanders

Kangalik carefully noses his one-man boat onto the beach of fine sand after two months of seal hunting at a spring camp with three other men. He pulls himself up and out of the circular hole in his decked-over kayak and steps out into the water. Then he fairly stands on his head as he reaches back into the stern to pull out what looks like a huge, limp bag which proves to be much heavier than any air-filled sack. It is the whole skin of a seal—a "poke"—, filled to bursting with seal blubber, the fuel for many a cold day or warm meal.

A woman runs down to give him a hand, and a swarm of children gather around to ask questions and hear the newsy answers. "No, Kusauyak and his wife are coming in tomorrow. Get that kayak-sled over there. We will put the poke on it. Ayagaktok killed five full-grown bearded seals. Fine! He is Best Hunter this year."

With this scene we have witnessed a crucial chapter in the strange chain of events that links the Nunivak Islander to the seal and thus to life.

The outsider wonders why Kangalik mentions only the five bearded seals and not the total of 22 seals of all kinds that Ayagaktok brought in. But that is the way on Nunivak. Each hunter is rated according to his catch of full-grown bearded seals, and the scores are known to all, like the goals of a polo player.

Carrying it like a stretcher, the two men lift the little sled with its big burden of seal oil and carry it to a storeroom, a log house half underground and covered with sod.

It takes Kangalik more than an hour to dispose of two more pokes and a surprising assortment of goods. No wonder the kayak almost had its sealskin decks awash: cooking and eating utensils, extra water boots made of sealskin, rain parkas made of intestine casing, fancy bag for personal belongings, made of whole sealskin, fur outside, and on the deck of the kayak an array of spears, harpoons, and other gear for hunting the seal.

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*When Margaret Lantis undertook to live for eleven months with the isolated Eskimos of Nunivak Island, she went as an anthropologist to a region which is scarcely known even to the professional anthropologist, let alone the general public. Her background includes a previous visit to the [illegible] Islands and teaching anthropology at the University of California where she received her training.

Of her experiences among the Nunivak Islanders who have not been degraded by contact with "civilization," she writes: "My life there was so delightful that I want to tell all those people who have winced at the bestiality of the Eskimos in de Poncin's *Kabloona* about the charm of my Eskimos. When the Eskimos have security in the form of plenty of seals and when their games and ceremonials have not been cast from them by encroaching civilization, they preserve an altogether admirable dignity and self reliance. They have the interest and patience to carry on the old-time activities of their distinctive life even when these are laborious. Especially on Nunivak has the fullness of the old culture survived. Most of the population is still unable to speak even a pidgin Eskimo English. The people are still using a wealth of ancient tools and doing beautiful carving; and the men's ceremonial house is daily in use as of old."—Ed.

WORSHIP THE SEAL

in Bering Sea still cling despite the introduction of civilized huts in many other Alaskan villages

(Above) A PORTION of near-by Nash Harbor Village, where the Eskimos likewise still live underground where they can keep warm. The log huts are all storehouses

(Above) A LIVE BABY HAIR SEAL delights the hunter's little sister when he brings it home from his spring hunting trip

The greatest activity in the hunting cycle is shown in the spring, when the break-up of ice calls every able-bodied man on the island to match his skill, strength, and supernatural power with his honored adversaries, the seal and walrus. For many weeks the hunter and his wife have been preparing for this heavily ritualized and emotionalized hunting season.

Finally the weather is right. Fasting and bathing ceremonially, the hunter puts on all his amulets and charms to give him power, dons a new waterproof parka and a large sacred wooden hat painted white and blue, with ivory decorations. He takes down from its rack his sealskin-covered kayak, which bears the painted blue figure of his protective animal, possibly a cormorant, sea gull, or mink.

Carefully he loads the slender one-man boat with all his gear. Even the narrow deck is piled with equipment: six-foot ice cutters and ice hooks to manipulate the kayak among the broken ice, meat hooks, harpoons, and spears, and a little board for throwing them, a great coil of harpoon line made of seal rawhide, and inflated floats made of whole sealskins. Finally he puts the sled on the kayak and is ready for either water or ice. In the water, the kayak carries the sled; on the ice, the sled carries the kayak.

After still more ceremony, including a food offering to the sea, the hunter shoves off, and his wife and children watch the white and blue thing disappear into the white of the ice and the blue of the sea.

The few weeks of feverish hunting before the ice entirely disappears yield the great store of niceties and necessities without which life would be impossible on Nunivak. With luck there will be quantities of meat, raw materials to clothe the family and fashion into new hunting equipment, and sea oil that can be burned in pottery lamps.

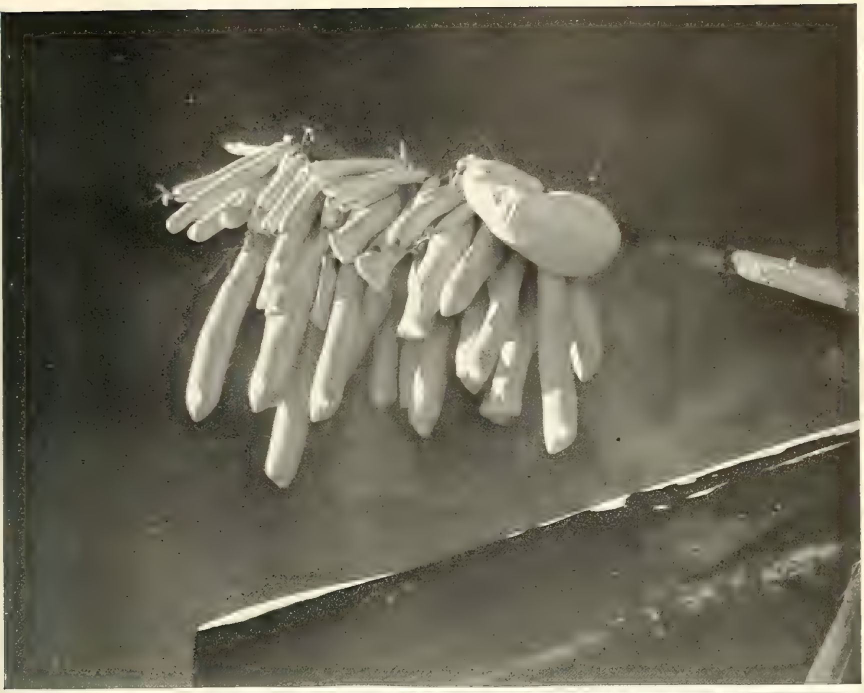
The Nunivakers utilize all of the seal except the grunt and—strangely enough—the bladder and bones. With natural reverence for anything so important in their lives, they fear the souls of the animals they kill, honoring the bones and the bladders (the seat of the soul) with sacred rites.

THE STAPLE FOOD of the Nunivakers is a little silver gray variety of hair seal *(above)* and a larger spotted hair seal *(right)*. Here the skin has been cleaned and stretched, ready to be softened by scraping and rubbing and made into clothing. Through the cold season the seals can be frozen solid like the one at upper left, to be used when the need arises

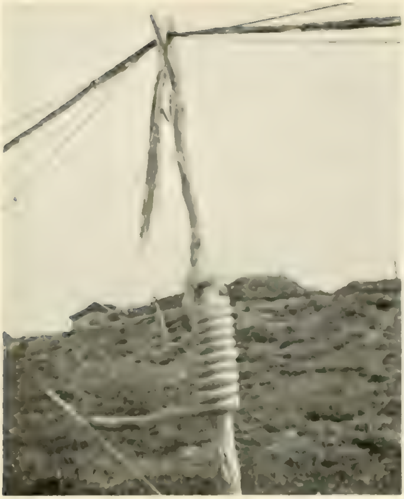
One village of 135 catches 600 or more seals each year, while a maximum of only about 35 walruses will be obtained by the whole island. The seal alone gives a dependable food supply, though there will occasionally be a sperm whale, killer whale, sea lion, dogfish, polar bear, or at rare intervals a bowhead whale

AS FAST AS the seals are caught, work proceeds rapidly at home. All the flesh of the little gray seal is dried in one piece as shown at left. The Nunivakers eat every morsel of meat, brains, eyes, heart, and liver

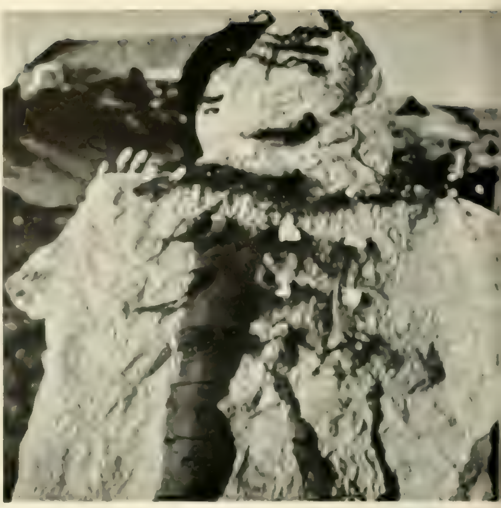
(Right) THE SKIN, still whole, is turned inside out, cleaned, and inflated. These seal pokes will serve as containers for that important commodity, seal oil, or as floats on the harpoon lines, to keep the captured animal from diving



(*Above*) A FAMILIAR SIGHT on Nunivak. Suggesting an elaborate sort of bagpipe and giving forth musical tones like a marimba when knocked together by the wind, these objects are in reality seal stomachs and esophagi, inflated. Like sealskin exposed similarly, they bleach to a beautiful snowy white when frozen in very cold weather. They will be used for trimming clothing and fancy bags



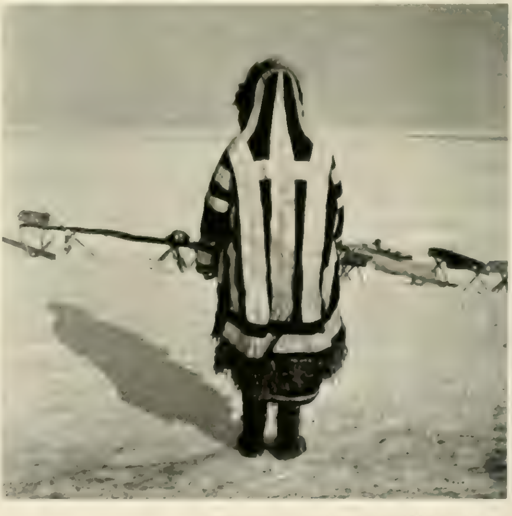
(Above) A SEAL INTESTINE inflated in the sun. The intestinal membrane of the seal or preferably the walrus is used to make waterproof clothing. Stretched above the intestine are sealskin harpoon lines, strung out to dry, with which to catch other seals. The lines are cut in a continuous spiral from a whole sealskin

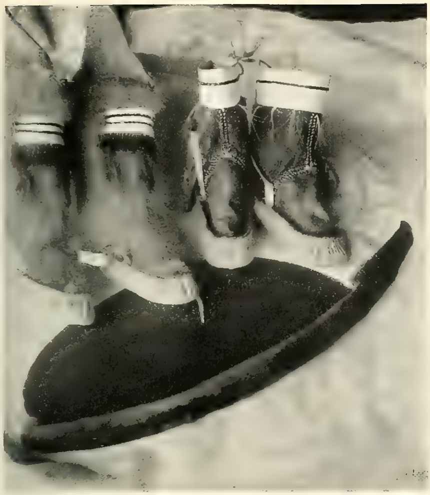


(Above) RAIN, WIND, AND THE WAVES will be thwarted by this jacket made of intestine casing. The back of the parka is shown by a young lady who was too curious to stay hidden. It is decorated with red dyed dog hair and white tabs of seal esophagus

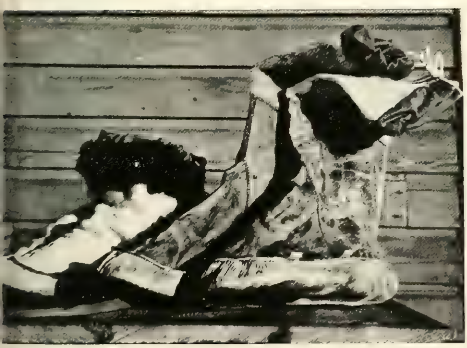
THE RAIN PARKA, tied tightly around wrists and waist, gives good protection also from the icy water when the fisher sets out his salmon trap—and sits on it

BLEACHED WHITE by frost, long strips of sealskin form a pleasing pattern against a darker background above a border of fringed seal fur. Beyond can be seen kayaks and on one of them the kayak-sled mentioned earlier





(Above) A WHOLE SEALSKIN is needed for each pair of women's boots, but the Eskimo boots above are dolls' miniatures. The woman's pair on the left, shorter than usual, is of gray seal, with reindeer trimming. The man's pair, waterproof, is of scraped sealskin, with bleached seal-throat borders. The black object is a large woman's-knife with rubbed slate blade, one of the main tools used in the manufacture of boots



(Above) LATEST STYLES in gentlemen's boots: models recently copied from the Norton Sound Eskimos of the mainland. A former seal poke, thoroughly saturated with oil and therefore highly waterproof, forms the uppers of the long ones. The soles of this pair are of bearded sealskin. The smaller ones have uppers of reindeer and beaver

(Below) YOUNG HARRY's sealskin parka and boots are the worse for wear, for his stepfather is poor, but he can smile, for he is the best swimmer among the boys and one of the most promising ivory carvers

LITTLE FELLOWS playing outdoors all day in the snow need high sealskin boots. The mittens here are made with the fur on the inside

(Left) RARE is the garment that contains no product of the seal. Even these reindeer parkas have gray seal cuffs. Note that women's parkas are always curved up the side, whereas men's are straight around the bottom

TO CAPTURE the seal the Eskimo must become something of a seal himself. He invades the seal's domain in a remarkable boat made of the skins of seals previously caught, stretched over a frame of driftwood. At right is seen one of the skins, scraped and being bleached as a future kayak cover

(Below) THE DECKS AND HULL of the completed boat glisten in the sun, for new kayak covers are beautifully white and clean, which incidentally pleases and attracts the seals. Seated snugly in the circular opening, the paddler becomes part of the boat, a fit adversary for the animal he hunts. In some sections, kayakers turn themselves completely upside down in their sealskin boats and right themselves without mishap

(Below) ANOTHER important use for the intestinal membrane is as a "windowpane," as shown in the skylight of the typical underground hut. Much light shines through the translucent material to the underground dwelling, yet it is wind and waterproof

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With these and a multitude of other things in daily use, the resourceful Eskimo converts the seal to his comfort and need. Is it any wonder then that the Nunivaker has a reverential respect for the animal and gives its bones a decent burial as for a man. Religious emotion reaches a peak in a great festival held each year in honor of the seal souls.

In late December after nine or ten days of solemn preparations, including the composition of new songs, carving of new boat [illegible], and completion of new clothing, the ceremony begins. The bladders of absolutely all the seals caught during the year are brought into the men's ceremonial house and hung from the roof. The soul of the seal, still in its bladder, is entertained. There are five days of singing and feasting. Ancient masks made of real animal and bird heads are worn, and the actors impersonate the spirits of the bearded seal, which come to frighten the little children.

On this last evening, when the spirits are called up, the year ends, and the bladders (that is, the souls) are put down under the ice to return to the seals' villages under the sea.

The seasonal circle is completed, and there will be hope for good hunting next year.

FEATHERED AIRMEN *of* MIDWAY ISLANDS

By THOMAS M. BLACKMAN

All photos from Three Lions

The traveler who sees the albatross at Midway Islands has progressed far beyond the Ancient Mariner in mode of travel, for these tiny specks in the Pacific are a stopping place on the clipper route from Hawaii to the Orient. The black-footed albatross or "black gooney" itself resembles an airplane in landing or taking off. The bird glides slowly down with tail spread and feet wide apart to insure good balance. Even so, an unsteady wind may topple the bird over before it safely comes to rest

Utilizing the same tiny dots of land as the clippers which fly across the vast Pacific, a multitude of beautiful birds add interest to the wayfarer's visit on these lonely airway outposts

Right in the center of the northern part of the Pacific, and a few minutes east of the International Date Line, lie Midway Islands. The two islands, each approximately two miles in greatest diameter, rise a few feet above sea level and are composed entirely of coral deposits.

Sand Island, the more westerly, is densely covered almost throughout with a bush known to the residents as beach magnolia *(Scaevola frutescens)*. This is the only plant of much size, except for some groves of ironwood trees *(Casuarina equisetifolia)*. Inland on Eastern Island the ground is generally much harder, and wherever the scaevola bushes are not too dense, it is covered with a variety of low plants and grasses.

Midway has received protection for birds during the past few years which has made it a veritable paradise for its feathered inhabitants as well as for the bird student. Cats and dogs are entirely absent, as are rats or other destructive vermin.

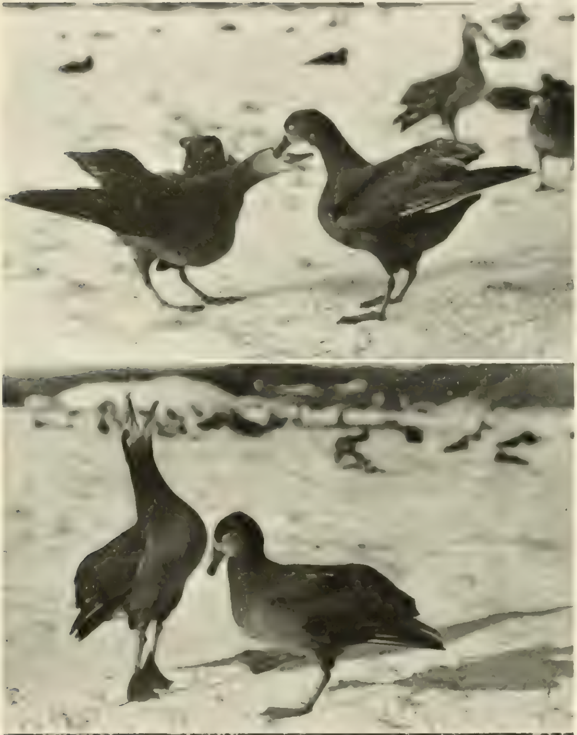
This protection has meant the survival of two land birds which were introduced in recent years from Laysan Island, 400 miles to the east, and have since become extinct there. These are the so-called Laysan finch and the Laysan rail. They are the only true land birds of Midway, except the introduced yellow canary, and they are found nowhere else in the entire world.

On visiting for the first time these remote islands, inhabited for many thousands of years by birds that until recently did not know man, one finds their tameness or unconcern most striking, a situation that might be expected in a fairy tale or imagined in a dream. You have the novel experience of seeing birds as large as the albatross remain still until you approach within a pace or two. And then, apparently even more inquisitive than yourself, the bird advances nearer and looks up at you without any show of alarm.

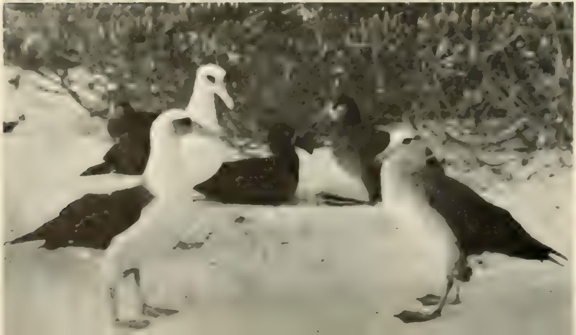
I was fortunate to remain in this metropolis of bird life from December 7, 1939, to May 14th of the following year, a period which included the nesting season of the majority of the birds. These tiny islands are, of course, the resting place of the giant clippers of the Pan American Airways on their way from Honolulu to the Orient, and the birds of Midway are certainly one of the interesting features to be observed by anyone pausing here on this transoceanic flight.

When taking off, the black-footed albatross must first find a clear space and, after spreading its seven-foot wings, run for 60 to 90 feet over the ground before rising. After a few slight strokes, the wings are set for the glide upward. These birds travel great distances with scarcely a perceptible movement of the wings, taking their rest as they travel

A BLACK GOONEY comes home to her chick. The nest is a mere scratching in the sand, which when damp may be banked up to a height of several inches



CEREMONIAL "DANCE." Usually in the center of a small group of onlookers, the participants begin by bowing, crossing bills, and shaking their heads from side to side while rapidly chattering their bills. At intervals and in turn each gooney raises one wing while nibbling beneath it; and at the conclusion both birds raise their bills to extreme height and utter a loud and deep "ah." The bird often shows such enthusiasm that it raises itself up on the extreme tips of its toes. Normally the finale comes when both birds adopt the erect attitude together, each reaching as high as it can. Generally supposed to have originated as a part of courtship, this exercise seems to resemble a competitive game and occurs at all seasons ashore. Having some of the elements of fencing or boxing, the game frequently terminates in a violent squabble, with sometimes a final derisive cry from the victor as the worsted participant walks dejectedly away



TWO KINDS OF ALBATROSS and a possible hybrid. Though the two species are not known to interbreed, the coloration of the right-hand bird is approximately midway between that of the black-footed albatross in the background and the Laysan Island albatross at left. On the other hand, it may be a yearling Laysan albatross. The habits of the two species are similar. Both return to their breeding grounds about the beginning of November after an absence of about two months at sea, and both indulge in the ceremonial "dance," though the Laysan albatross does so less enthusiastically

A FALL OF SAND at the entrance to their burrows frequently traps both Salvin's white-breasted petrel *(above)* and the wedge-tailed shearwater. Both are abundant at Midway and are mainly nocturnal in habit. In the loose ground on Sand Island the burrows are often six feet or more long and sunk to a depth of two feet or more, elsewhere considerably shorter. Over much of Sand Island the ground was so tunneled with these burrows that the author found walking extremely difficult, not to say dangerous. Even when exercising great care, one would repeatedly sink knee-deep

AN ASTONISHING scarlet throat pouch *(upper left)* distinguishes the male frigate bird in the breeding season. When distended, this brilliant adornment gives the bird a very grotesque appearance and is probably instrumental in producing the varied warbling heard when the males sit around the nests in company with the females. At such times the head is repeatedly thrown back, and a rather pleasant sound reminiscent of water bubbling mingles with other notes resembling the cooing of a male pigeon

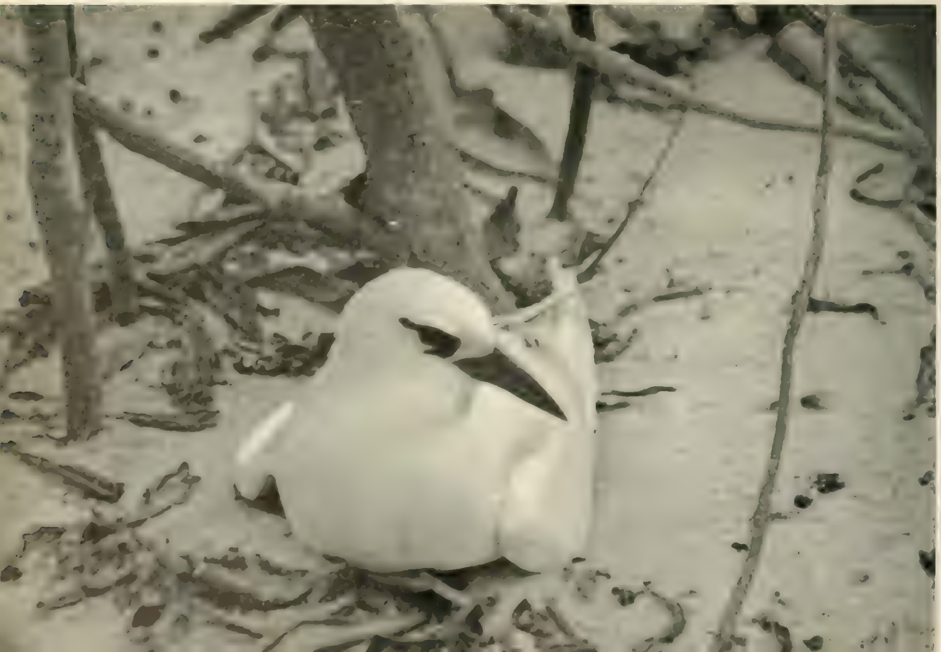
THOUGH the frigate bird is said to be lighter for its size than any other known bird and is one of the most expert flyers, it is virtually unable to rise from the water or from level ground. The nests on Eastern Island are built on the tops of bushes from five to eight feet high. Even from this point of vantage, it was noted that the birds spread their wings carefully a few seconds before taking off, apparently waiting for a favorable air current to assist them in their rising

A BOLD THIEF is the frigate bird. Whenever it finds a nest unguarded, this pirate among birds deliberately breaks the egg and then proceeds to pull the nest to pieces, carrying the material away for its own use, until none remains

THE FRIGATE BIRD obtains most of its food by chasing and robbing other sea birds. Waylaying the returning boobies and others it gives chase and forces its victims to disgorge their hard-earned meal and shows much skill in catching a fish in its fall before reaching the water

ACROBAT OF THE AIR. Especially on hot sunny afternoons, the red-tailed tropic bird, or "bo'sun bird," displays aerial maneuvers in small groups. Circling around together, one bird after another hovers with tail spread forward beneath the body and travels *backwards* three or more feet in perhaps as many seconds with vigorous beatings of the wings, then shoots ahead again.

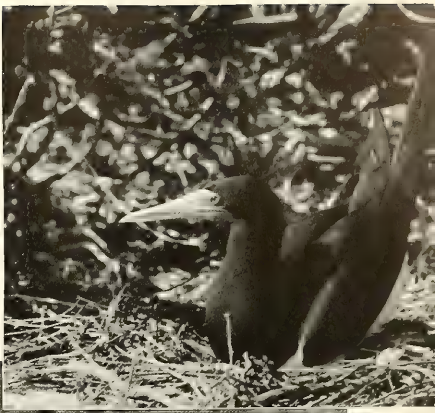
This bird is slow and awkward on the ground, but is one of the most exquisitely colored of all birds, having satiny-white plumage, scarlet and black bill, and long crimson and black tail shafts *(below)*. The supreme touch is added by a soft rosy pink tint of the body plumage which is variable in the species and fades rapidly in museum specimens. The bird lays one egg on the bare ground beneath the shelter of bushes

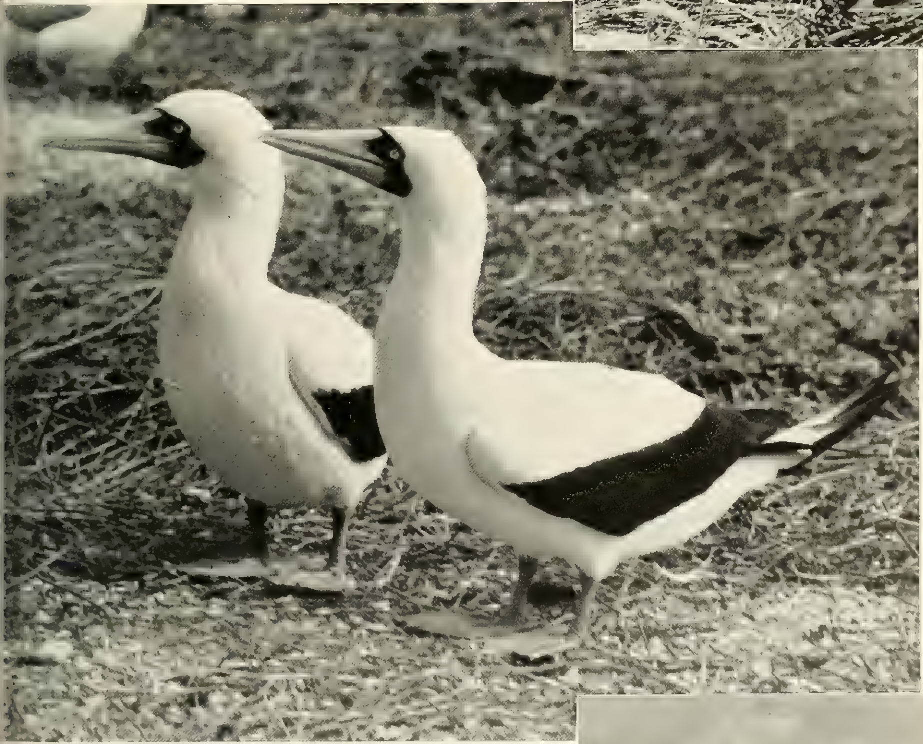


Victims of the frigate bird's piracy: two species of boobies. The common or white-bellied booby *(at right)*, of which this is the Pacific form, has a wide distribution in the tropical seas. This bird makes a rough nest of sticks and dead leaves on the ground beneath or just outside the bushes. It lays two eggs of a slight greenish-buff tint, incrusted with a white limy deposit. So serious are the depredations on the young, however, that no instance was observed of more than one young bird surviving beyond mid-growth.

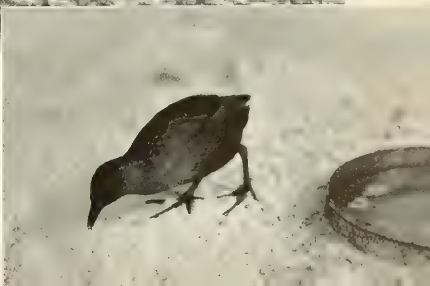
The blue-faced booby *(below)* is a stouter bird about the size of a goose, pure white in plumage with black wing patches. Like all the boobies, it is an expert diver. It hatches its two eggs on the bare ground, with little or no attempt at nest making. Both chicks seldom reach adulthood.

A third booby, the red-footed booby, also nests at Midway. This bird is marked much like the blue-faced booby, with a broad patch of slaty gray on each wing, and red feet. It nests on bushes and gets along with one egg





(Right) Found nowhere else in the world, the Laysan rail, like the Laysan finch, has survived exclusively on Midway Islands after its extinction a few years ago on Laysan Island. This bird is completely flightless and may frequently be seen to enter the burrows of petrels and shearwaters, sometimes remaining two or three minutes. This bird is inquisitive and fearless. It enjoyed drinking and bathing when a pan of fresh water was put out and refilled each day, though fresh water was never found on the island except in rainy weather



(Above) The Laysan Island finch is now abundant over the entire area of both islands and helps man by restricting the growth of an objectionable trailing plant, *Tribulus cistoides*, whose seeds are its favorite food. The bird spends much of its time searching the ground for these seeds and shelling them, for which its broad bill is well adapted. Strictly speaking it is not a finch but a member of the Drepanididae, or Hawaiian honey creeper family

The Hawaiian sooty tern, or wide-awake tern, nests in large colonies on Sand Island. The season's first were seen to arrive on February 18th, and by March 9th their numbers had increased to many thousands. Egg-laying began around May 10th. The bird lays a single large egg on the sandy ground with little or nothing in the way of a nest. Many of the birds left their eggs quickly when approached closely, but others were more fearless, and some few even advanced to attack the camera.

The male birds were often seen walking about their mates, their necks stretched forward and wings drooping almost to the ground. Frequently they would chase away other male birds that ventured too near

(Below) This is the Pacific form of the noddy tern, which has wide distribution in tropical seas. When the author visited their nesting grounds on January 7th, at which time many were found with eggs and some with young already half grown, the old birds proved very aggressive. Flying up from their eggs or young, they quickly returned to make savage swoops at his head, and more than one inflicted a cutting stab with its strong, sharply pointed bill.

The bird is fourteen to seventeen inches long and sooty brown in color, with the neck grayish and forehead light gray in the adult

WINGED GRACE. The Hawaiian tern is like a small and blacker edition of the noddy tern. Unlike the latter it makes a substantial nest in bushes or trees

(Below) WINTER VISITORS at Midway: three of the five species of shore birds which regularly pass the season in these remote islands but breed elsewhere. The bird on the left, the bristle-thighed curlew, is now known to breed in western Alaska. It is much less plentiful at Midway than the golden plover, at upper right. The golden plover comes each winter from its breeding grounds in Alaska and northern Siberia, and is distributed over the entire area of both Midway Islands. Each bird has its own hunting grounds where it searches for the insects on which it chiefly feeds. Fights of a more or less severe nature sometimes result when others of its kind encroach upon its domain

The wandering tattler *(lower right)* is slightly more slender than the golden plover, and more somber. It is seen frequenting the Midway shore line singly or with plovers and turnstones

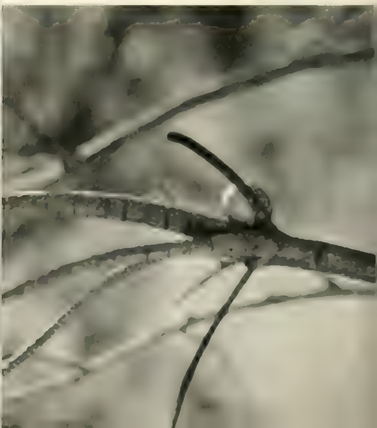
Midway's other two winter "vacationists" are the ruddy turnstone and the sanderling. All five species breed in the far north. The sanderling apparently leads the spring departure from Midway about May 3rd; the turnstones follow perhaps a week later; and the plovers and curlews hold on longer

ONE of the most charming birds is the white tern, or love tern, whose elegant appearance and gentle ways endear it to everyone. It has plumage of pure white, with a ring of black feathers around the eye. Although frail and delicate in appearance, the white tern is an expert flyer and travels great distances over the ocean to obtain the small fishes upon which it lives. Bringing its catch home to feed the young, it loads its bill from base to tip with two-inch silvery fishes, leaving the spectator to marvel how the last one could have been caught with the bill already full

(Below) THE MOST ASTONISHING THING about the white tern is its fantastic choice of a nesting site. The bird below is sitting on its egg

(Right, below) SO PRECARIOUS is the resting place of the egg that the parent bird sometimes dislodges it in flying away. Almost any imaginable place may be chosen, even a slight depression in a branch or a spot where the roughness of the bark will prevent its rolling. The young chick must of course be an acrobat from the moment it hatches out. It clings to the bark in the same position as the egg until nearly fledged.

The foregoing are the most important birds of Midway. Numerous yellow canaries (all said to be descended from a pair imported in 1909 and two males brought from Honolulu in 1910) and occasional accidental visitors complete the list of winged creatures which utilize tiny Midway Islands, as man has recently begun to do, as a resting place in the broad expanse of the Pacific



ATTORNEY FOR THE INSECTS

Frank E. Lutz has devoted much of his career to reminding his fellow men that they owe their very existence to that ancient and honorable form of life, the insects. As Curator of Entomology he has contributed greatly to our knowledge of their behavior by his studies in field and laboratory

By D. R. Barton

We know not what other characteristics may reasonably be expected from a blend of Connecticut Yankee and Pennsylvania Dutch, but a fusion of these hardheaded strains is apt to produce more than a match for ordinary men at the shrewd art of bargaining. A good case in point occurred in a small Pennsylvania town just before the turn of the century when Frank E. Lutz, then a student on vacation from Haverford College, was informed by his father that some sort of bug was devouring a sizable section of woodland several miles from home. Lutz, senior, who was merely Dutch, attached no special importance to this news beyond its general interest to the neighborhood. Nor did his wife, who was merely Yankee. But the double dose of shrewdness instantly became manifest in their son. He suspected "walking sticks" (phasmids) of being the flies in this particular ointment and, though he did not then know how rarely these insects gather in numbers sufficient to do such extensive damage, he had heard of a firm in New York which made a business of mounting them. Young Frank wrote at once, inquiring prices. A penny apiece was the big city's answer; the writer of the letter doubtless estimated that this country lad might conceivably earn a quarter if he worked really hard.

Frank worked hard all right. He had several large flour sacks and set about cramming them with the teeming multitude of six-legged pennies which abounded on every side. In fact, so great was the embarrassment of riches that he was soon knocking off a dime's worth at a clip by flailing at the surrounding branches with a stick. When the sacks were filled, he boxed and shipped them to the writer of the letter, expressing the respectful hope that the firm liked its specimens not only fresh but alive. He added that though he was sure of at least 2000, he had been unable to take an accurate count and would settle for $15.00. When the package was opened, the recipient had to clear his front office of a swarm of disgruntled phasmids anxious to stretch their 12,000 limbs after a most crowded journey. Needless to say, the man was glad to settle. He had had all he wanted of "innocent country lads." And it would certainly seem that this Lutz boy was another Abner Slick of Punkin Crick—a sharp dealer to whom everything in the world, including bugs, was a plain matter of dollars and cents.

Frank E. Lutz

This was, it is true, the first money Frank Lutz ever made out of entomology. Yet when he became a museum curator and acknowledged master of that science, he wrote:

> "I call the insects that are living in the lot on which we have a home 'our six-footed guests.' I am supposed to have purchased the land by giving a piece of paper that entitled the bearer to a number of shiny, metallic disks; but no six-footed creature signed the transfer, and the ancestors of many of them had squatter rights here long before any man lived anywhere. Furthermore, some of them assert their rights when I plant things that suit their tastes. . . . Insects are a benefit to me because I like to watch them. If I am a benefit to them by making a nice flower bed in which they can live, so much the better." And again, "Do not think too harshly of all mosquitoes. . . . No mosquito is vicious. If she bites she bites not in anger but in hunger. I rather like mosquitoes."

Surely these are not the words of a tightfisted materialist. Rather is there a touch of saintliness, and one might even recall the Christian ascetic who willingly suffered worms to mortify his flesh, replacing them on his person if they chanced to fall off. At the very least such talk introduces a paradoxical note that seems to pervade the whole story of Doctor Lutz's career. For example, his studies have taken him to Europe, and his Museum expeditions not only to all the principal sections of the United States but to the West Indies and South and Central America as well. He has investigated the faunal relations between Florida and Cuba and shed light on the geological history of the whole Caribbean area. Yet what he himself considers his most important work was done almost entirely in the back yard and cellar of a prosaic suburban house a few miles outside of New York City. Equally arresting is the fact that he came to the Museum as an entomologist without formal training in that subject beyond an elementary undergraduate course. Moreover, one learns with a measure of wonder that his first two papers, as a museum entomologist were "A Brief History of Antarctic Exploration," and "String Figures from the Patomana Indians of South America." Yet a bare half dozen years later he was able to write his *Field Book of Insects* which has been a "steady seller" ever since.

Doctor Lutz's own education was largely made possible by winning scholarships and waiting on table. Nor [illegible] caused Frank to start out on a [illegible] through Haverford he decided on medicine and switched to biology, which department offered a course in [illegible] take this course, although it bobbed up in the catalogue year after year. But Frank had an open elective and [illegible] strode the rostrum and flourished his pointer at blackboard outlines and diagrams quite as if a hundred young men were scratching busily at their note- [illegible] ing the third lecture Frank quietly dropped off to sleep. Being practical even though a pedagogue, the profes- [illegible] examination would be given at the end of the year.

That was the sum and substance of Lutz's entomological schooling. He passed the exam with flying colors, but on graduation he needed a job and tried to work "back" into the actuarial game, drawing a complete blank. Then, "canvassing the teaching situation turned up only an offer of '$200 a year and a good home' in a private school. It involved teaching Latin and playing the chapel organ. I hated Latin, having nearly flunked it in college, and my entire musical education consisted of a few lessons on a reed organ when I was a small boy. The 'professor' owed father some money, I guess, and that was the only way father had to collect it.

"College practically over; no job; and no money to go on with medicine. Then my professor of biology, H. S. Pratt, had an idea. Biometry, a combination of mathematics and biology, had reached America and its chief ex- [illegible] in America was C. B. Davenport of the University of Chicago. I had specialized in both mathematics and biology. Biometry, a thing I had never heard of before, seemed to be my kismet. Why not apply for a scholarship at Chicago in biometry?"*

Lutz throve on the subject and sub- [illegible] student of the revered London bio- [illegible] Karl Pearson.

But it was the home-grown Professor Davenport who, indirectly, piloted Lutz into the American Museum. In the early nineteen hundreds the Chicago biometrician moved to the then newly organized Station of Experimental Evolution at Cold Spring Harbor, Long Island, whither Lutz followed to apply biometry to a study of heredity. Insects, because of their profusion, are excellent material for this as for almost any other work involving large figures. Lutz's major opus at Cold Spring Harbor was a paper on the heredity of fruit flies. This contribution asserted results that seemed to run counter to Mendelian laws. The latter still stand, but Doctor Lutz sticks to his own guns after 30-odd years, demonstrating a pronounced tendency toward scientific heterodoxy, of which more anon. Incidentally, both crickets, which were the subject of his doctor's thesis, and fruit flies have figured prominently in Lutz's leading experiments, which may possibly indicate that the general direction of his course was fixed relatively early in life.

Museum Appointment

Doctor Bumpus, who directed the affairs of the American Museum in the early part of the century, met Lutz at Cold Spring Harbor and was sufficiently impressed by his skill at general biology to sign him up for this institution. Today Doctor Lutz is a gray-bearded savant, but this fact does not deter Bumpus from addressing him as "Bugs" and signing his letters, "Dad," which should give some idea of the closeness of their relationship.

The Field Book of Insects amply demonstrates Doctor Lutz's taxonomic interests. For more than 30 years the Museum's large entomological collection has been his primary concern. Nevertheless, his vocation for experiments on insect behavior has persistently beckoned him away from the "regular" work, so that taxonomic research is left largely in the hands of his departmental assistants. And theirs are capable hands, indeed. For, about 180 new insect species are described every year by the Museum's Entomology Department, a record which averages a new species every other day. On the other hand, the name of Frank E. Lutz will perhaps be longest re- [illegible] mental biology.

[illegible]

Had Doctor Lutz come of age in the early colonial period of our history, his household activities might easily have roused the neighbors to the point of burning him at the stake. As it is, he has from time to time managed to clutter up his property with the [illegible] assortment of pets and gadgets and to behave in the most extraordinary manner, without straining the patience of an unusually indulgent wife and a remarkably tolerant neighborhood. Imagine glancing out the window to find the man next door crawling along his lawn, listening to a clump of shrubbery with a stethoscope. Such a sight scarcely elicits more than an amused smile on Doctor Lutz's street. People know he's just listening to some bug or other (crickets* in this case) and dismiss the matter without pause. Nor did they raise objections when he and his fellow communicant of the devil, Dr. E. N. Grisewood, of the City College Physics Department, rigged up a "peanut whistle" in the back yard that blew one shrill, piercing note all day long. The object was to discover whether certain bees are sensitive to certain sound waves. And are they? Doctor Lutz doesn't know. But the experiment was not a complete failure. It furnished an acid test of the good will of all those within earshot.

The lavish hand with which Grisewood and other physicists can conjure up an elaborate testing apparatus replete with dials, gauges, and glowing bulbs is a source of wondrous joy to their entomological confrere. He and Professor Richtmyer, a Cornell physicist, working as members of a National Research Council committee demonstrated that insects can see ultraviolet beyond the range of human vision, and that flowers, both wild and cultivated, have ultraviolet patterns, a fact not previously recognized and one that reveals a new factor affecting the pollen-carrying practices of insects. What is even more amazing, Doctor Lutz and Professor Grisewood, working in the former's cellar, showed that fruit flies are markedly responsive to an extremely short wave-length, one that is so short in fact that it is practically absent from the sunlight that reaches

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[illegible]

the earth and therefore *could not possibly have been previously encountered by the insect or any of its ancestors as far back as science can determine.* This astonishing disclosure left the investigators wondering how the fruit fly had come by such unique powers of vision. And of what use could they possibly be? "None, so far as I know," writes Doctor Lutz, "and that is one of the things that make me quite willing to believe that also other things in Nature 'just are.' "

"Anti-utilitarian"

Though he has failed to draw upon himself the unreasoning wrath of his neighbors, such statements have prompted certain scientific sects to burn Lutz as a heretic. And if he does not watch his step their actions may become stronger than this mere figure of speech. For Doctor Lutz has long been an extreme sceptic and a confirmed "anti-utilitarian."

Ever since his days at Cold Spring Harbor, he has been probing the private lives and potentialities of fruit flies. "Just at present we have at home pure-blooded normal flies and pure-blooded wingless ones. . . . You may wonder why we keep a strain of wingless Drosophila in our home. It is partly because they are just as interesting as goldfish and partly because they are handy food for pet mantids, spiders, and the like."

While these "handy" creatures were undergoing the ordeal of artificially selective breeding, Lutz became interested in their "courtship dance" (they actually perform one) and decided to experiment with their so-called secondary sex characters. What he singled out for study were the "tibial combs" which had glibly been labeled as "adornments" useful in attracting the opposite sex. But when Lutz removed these appendages there seemed to be little noticeable difference in courtship behavior, and he felt that he had scored another point against the "selectionists" who regard all individual characters as having been selected and preserved by Nature because of a specific utilitarian purpose that increases the organism's power of survival.

Lutz disagrees. Like others, he trained bees to associate food with a particular color. And that, he maintains, is all there is to this business of flowers "advertising their wares" to bees. The bees may associate a particular color with food. But it is the food and not the color that attracts them. Moreover, Lutz's garden experiments disclosed that the black-eyed Susan, to take a familiar example, has brilliant ultra-violet tips to the "petals" which are clearly visible to the bees even though they look uniformly yellow to us. All of which thickens the plot. To quote:

"It seems to me reasonable to conclude, or at least to suspect, that floral colors have developed simply as by-products of the plant's metabolism; that they are at most of only incidental and minor service to insects in finding flowers; and that they have not been developed by any action of natural selection. These colors may be of no more value to the plants than are the colors of the purely pathological galls on the leaves and stems. It is certainly not going too far to change the old expression 'whatever is is good' to a more moderate 'whatever is is not bad.' If we can bring ourselves to do this, we can think of even the colors of flowers in terms of plant physiology instead of solely in the more attractive and exciting terms of advertising and the struggle for existence.

"There are other subjects in which some well-conceived and satisfying theory seems to have so quelled our curiosity that we stop thinking about it and repeat the approved formula like a litany. For example, it is said that a yellow spider in a yellow Evening Primrose is yellow so that insects coming to the flower will not see the spider and will be caught. The spider's color matches the color of the flower *as we see it* and the explanation formula is conveniently at hand. Why worry? Insects might be presumed to have a keen—in fact, a vital—interest in this matching of colors, but they can see ultraviolet and it happened that the only spider of this sort that we tested was only very slightly ultraviolet, although the Evening Primrose on which it sat was strongly ultraviolet. The colors did not match at all in the eyes of the insects. If insects 'explained' the color of that spider they would use a different formula.

"Evolution there certainly has been, and without doubt natural selection places limits beyond which variation may not go; but these facts give us no license to place the burden of the universe upon Selection's houlders until we have a better knowledge of that burden's weight."

The hardy insects

At one time, the Lutz cellar housed a colony of crickets who were being subjected to artificial "nights" and "days" in order to check their response to changed daily rhythms of light. Lutz set an alarm clock to wake him every two hours so he could go down and watch. But he soon found himself sleeping through the alarm and had to invent a machine:

"A delicately balanced treadle was put in the middle of each passage-way. When a cricket stepped on this treadle, as it must in going from one end of the cage to the other, its weight depressed the treadle, completing an electric circuit that included an electromagnet. When the circuit was completed this magnet pulled aside a recording pen that was otherwise tracing a straight line on adding-machine paper. The paper used was wide enough to accommodate six of these pens and was kept moving at a constant rate by, according to circumstances, either an eight-day spring clock-work or a motor such as is used in electric clocks. The movement of the paper was regulated to be about three inches per hour and one of the pens was used to mark the hours, being electrically controlled from an accurate clock. The ink reservoir of each pen (also homemade) was of such a size that the supply of ink was sufficient for several days of recording.

"An incidental advantage of this machine was that it greatly impressed those of our friends who came to the house. They saw an array of ten or eleven cages with electric wires going from them to one or the other of two contraptions made up of what looked something like a battery of telegraph instruments, each contraption rolling out a strip of paper bearing jiggled red lines. A cricket would walk across one of the cages; there would be a click, and a new jiggle would be made in one of the lines. A much greater advantage was that, without disturbing my sleep or greatly taxing my daytime attention, I had an accurate, detailed record for each insect every minute of day and night."

Sometimes Lutz deserts his cellar for a genuine physics lab, and when he does, things begin to pop. Perhaps his most sensational experiment involved duplicating the atmospheric pressures existing at high altitudes in order to find out how high above the earth's surface insects could travel and still survive. Supposedly "frail" fruit flies did not even stop walking around when Lutz set the atmospheric pres-

[illegible] terrific, one-to-three minute swings from normal air pressure to "none" [illegible] bred these two survivors and found their children, grandchildren, and great grandchildren absolutely normal. [illegible] beetle, and an immature grasshopper to [illegible] man could devise—conditions so drastic that moisture was literally sucked out of the insects and frozen into snow. One of the physicists who watched the experiment about to begin remarked drily that one hardly needed so much apparatus—one could simply step on the bugs and get the same results. But except for a single ant all of the assorted bugs survived in excellent shape, even though they were plunged instantly back to normal conditions by smashing the vacuum tube with a hammer.

Under such duress you and I would have been simply torn to pieces. "All we can say," Doctor Lutz concludes, "is that insects seem to be better made than we are. They have invaded almost every bit of livable world, including hot springs and the highest mountains, the Arctic and the Tropics, in water and on water, under ground and above ground, in plants and animals and on them. Only the ocean is largely avoided by them (although some water-striders actually exist in the middle of it). Their structure and modes of living have stood the test of time practically unchanged since the Carboniferous. Possibly Maeterlinck was right when he called them 'beings so incomparably better armed and endowed than ourselves, concentrations of energy and activity in which we divine our most mysterious foes, the rivals of our last hours and perhaps our successors.' On the other hand, as has been pointed out, relatively few kinds of insects seriously injure us and we owe much to many kinds. Possibly, with increased knowledge of insect habits, we may be able to swing the balance still more in our favor.

"What good are such experiments as these? Possibly collecting interesting [illegible] collecting human masterpieces of art; but, until someone is wise enough to be able to predict the worth of any bit of pure (as contrasted with 'applied') science, we can at least say that it is interesting."

[illegible]

Here we see what appears to be the keynote of Lutz's thinking. He objects to the taking of Man (and his pocketbook) as the measure of all things. And his case is strong. "Unthinkable millions of bees and other flower-visiting insects have given the world fragrant, conspicuous flowers and luscious fruits instead of nothing except such things as pines and grasses. Then, thanks to the activities of insects, and only then, was the world ready for man. Except for corn there is not a vegetable in our garden that did not come from an insect-pollinated plant. Think how largely cotton—its fiber and its seeds—enters into our 'civilization,' whether there be peace or war. Has it occurred to you that without insects we would have no cotton? We owe the shirts on our backs to insects, even though those shirts be linen, for flax flowers are insect-pollinated. Silk is, of course, an insect product. Wool? Well, sheep might be raised on timothy (wind-pollinated) hay but they are not. Clover and legumes (insect-pollinated) are sought. The sheep-growers of New Zealand found that, although they could grow clover from seed, they could not grow seed on clover because there were no bumble-bees in New Zealand. So, they imported the insects that were needed there to make sheep-growing profitable.

"Do you smoke tobacco? You wouldn't if it were not for insects.

"And so on to an extent that no one has, as yet, fully noted.

"Yes. A relatively few kinds (not 1%) of insects, chiefly kinds that have been introduced by Man—*seriously* injure our crops, but, considering insects as a group, they take no more than a moderate commission for the work done. Furthermore, there are thousands of kinds of parasitic and predacious insects that, far more effectively than we can do it, keep most of their native relatives in check."

No, Doctor Lutz's pulse does not quicken at the word "man," which to him signifies merely a belligerent mammalian biped with its own peculiar and not altogether winsome behavior pattern. One gathers that if the forces of man were drawn up in martial array on one side, and those of the insects on the other, he would be hard put to it to restrain himself from taking his stand with the bugs. Probably so harrowing a dilemma would send him off to some barren hermit's cave in the wilderness wherein he might renounce the world and all its inhabitants.

The [illegible]

Although he makes his living as custodian of one of the greatest, constantly growing collections of pinned specimens on earth, he definitely prefers his insects alive and usually will not even use poisons in his suburban garden. Fellow horticulturists are aghast at his calm toleration of various "pests." And nearly everyone squirms when he remarks that he has counted 1402 different species of assorted bugs in his back yard. "What an awful place it must be," they exclaim. Upon which Doctor Lutz may dangle the first place silver medal, the two second place bronze medals, and the certificate of achievement which the New York *Herald Tribune's* garden contest judges have awarded this yard within the brief period of four years.

How Lutz came to count those 1402 species takes us back to his early days as a curator when he was trying to persuade the Museum's Director to increase the number of entomologists. With half a million species known and fully as many more awaiting discovery, his staff was carrying (and still is) an insect load of 100,000 species per man. To drive home his point, he offered the Director the following sporting proposition. "I bet there are more than 500 species of insects on my own 250 x 75 foot lot. You reduce my salary by $10 for every one *under* that number and increase it for every one *over* 500 that I honestly find." Had that bet been taken, Lutz's income would have been increased by almost $10,000 a year. And though it hasn't been, this adventure into bug census-taking has now borne fruit. Under the waggish title of *A Lot of Insects,* Doctor Lutz has given us the cream of his vast experience with the foremost members of the insect legion which he welcomes as guests in his home. Partly memoirs with touches of autobiography and not a little philosophy, and partly popular science most engagingly written, this work should reach a far wider audience than *The Field Book*. At bottom it is a splendid brief defense and praise of insects and one that deserves and will command an attentive hearing. Even the most hardened insect-baiters will melt before its persuasive charm, and one need have no predisposition toward entomology to enjoy and profit by this summing up of an outstanding scientific career.

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YOUR NEW BOOKS

THE HISTORY OF NATURAL HISTORY IN AMERICA ● ART
LIFE HISTORY OF A SALMON ● YUCATAN FOLK CULTURE
GREAT LAKES FISHES ● INDIAN AGENT ● BUTTERFLIES

RETURN TO THE RIVER

by Roderick L. Haig-Brown

[illegible]

A[illegible] salmon [illegible] fresh water [illegible]

The [illegible] Columbia River, to its return and spawning in the identical pool where it was hatched. Thus the much that is known of the life history of this interesting and noble fish is presented in the form of fiction, which also permits rounding out the story with accepted theories concerning what has not yet been proved. Methods of salmon investigation, and various problems faced by the important Pacific coast salmon fisheries are touched on incidentally. In short we have here a picture of a great fish, and of an important natural resource with unobtrusive side lights on its conservation.

It would be a mistake to use details of the story, especially those not directly concerned with salmon, as a source book of scientific fact, and even features of the general picture might some day have to be altered. But as a picture it is true to our present knowledge of the subject, reads easily, and can be recommended to any [illegible] in fisheries research.

[illegible]

BY THEIR WORKS

by H. Phelps Clawson

Buffalo Society of Natural Sciences, $4.00

H. PHELPS CLAWSON has set forth [illegible] By Their Works, namely to provide a historical and social background for an exhibition of primitive or, more accurately, [illegible] the American Museum and other institutions, there have frequently been guides or textbooks written around specific collections, there have frequently been guides [illegible] base for a volume on primitive art.

The illustrations are well-chosen and [illegible] pictures and is informative rather than literary or philosophic. The result is a [illegible] interested in art or ancient history. It is [illegible] museum materials of this nature in class work. Mr. Clawson merits the thanks of museum workers and museum users for his valuable contribution to the literature [illegible]

George C. Vaillant

THE FOLK CULTURE OF YUCATAN

by Robert Redfield

University of Chicago Press, $3.50

IN our efforts to build a hemisphere solidarity in the New World, we find a community of ideas based on European culture, but in many of the Latin Republics we observe that a great sector of the population does not respond to these concepts and lives in a world part Indian and part Spanish colonial. Professor Redfield in *The Folk Culture of Yucatan* explores this important aspect of Latin American society, which, according to our North American white collar thinking, is a twilight zone. He does for Yucatan what he did for Tepoztlan in central Mexico, and what Dr. Elsie Clews Parsons did for Mitla in southern Mexico, namely a carefully detailed study of the impact and interrelation of different cultures and their effect on the community.

Yucatan is a geographically isolated state, having but a single port, Progreso, and a single city, Mérida. There is a large Indian population which retains its own language, and a small white group dominating the former in terms of economics and class. Thus, of all the areas in Latin America, Yucatan is the place where culture amalgamation and conflict can be studied under conditions most nearly approximating the ideals of the laboratory. The Division of Historical Research of the Carnegie Institution of Washington, under the Chairmanship of Dr. A. V. Kidder, implemented its historical research in archive and ruin by an analysis of modern social conditions. Doctor Redfield set up the organization composed of extremely able observers. Their research centered on four communities, an isolated Indian tribe in Quintana Roo, an Indian village recently opened to modern contact, a town exposed to continuous white contact, and the urbanized regional capital, Mérida.

Doctor Redfield summarizes the broad [illegible] findings in respect to such sectors of human interest as differences in life according to type of community, race and class, the Spanish and Indian heritages, culture organization and disorganization, views of life, money, land, and work, the nature of the family. He likewise analyzes the decline of the gods with the consequent transitions from holy day to holiday; medicine and magic; and our basic conflict today, the clash between the choices opened by civilization as opposed to the conduct rules of folk culture.

The result is a highly important book, the fruit of the measured judgment of the most experienced social anthropologist in North America, and the most intelligent. The powers at work in our society have to be evaluated and understood before we can gauge the social conditions in other communities and Doctor Redfield brings to his task a rich and fearless understanding. *The Folk Culture of Yucatan* must be read thoroughly, for the text is packed with carefully weighted considerations. There is no setting up of startling analogy for the sake of dramatization and steaming up reader interest. Yet Doctor Redfield avoids that crabbed virtuosity of playing jackstraws with technical terms, that perverts much of our academic writing. *The Folk Culture of Yucatan* is an enduring bridge between the knowledge of the expert and the general understanding of the educated man.

George C. Vaillant

NATURAL HISTORY AND THE AMERICAN MIND

by W. M. and M. C. Smallwood

Columbia University Press, $4.25

THIS book is one of a series, "Studies in American Culture," designed to provide historical reviews of aspects of culture often neglected. It is thus a history of natural history in America, and covers the period from Oviedo, who came to America in 1512, to the time of Agassiz and the development of biology and geology as sciences.

The early naturalists were heirs of the medieval age of faith, the world had been greatly enlarged by the discoveries of the East and West, and the scientific work of the Greeks had been only recently recovered. They were all somewhat naive and credulous by modern standards, but from the first many of their observations in the New World were well-founded.

For a long time the influence of European naturalists and educational institutions was paramount in the field of American natural history. The great medical schools of Leyden and Edinburgh attracted students from the growing cities of the American seaboard, Charleston, Philadelphia, New York, and Boston. Many of these students studied natural history abroad, and when they returned, formed societies, started museums and botanical gardens, and taught interested persons. Soon work was being done and books appearing that were comparable to the work of European naturalists. By the end of the period described here, natural history had come of age in the United States.

The authors have taken a great deal of pains to gather the material together, studying original sources in European museums as well as in this country. A bibliography of about 90 pages is appended and the book is illustrated by ten selected reproductions. It is not a book to read for entertainment, but contains much of interest to naturalists.

J. E. Hill.

I LIKE BRAZIL

- - - - by Jack Harding

Bobbs-Merrill, $3.00

THIS is a book of first impressions, gathered on a trip to Rio, Pará, Manáos, Recife, São Paulo, and various other places. Mr. Harding talked to a lot of people and put down what they said, which covered a wide range from the 1930 revolution through the problem of coffee to the good neighbor policy. Dealing in first impressions, the author has no critical judgment on what he heard and wrote; hence one is surprised to find a number of such absurd statements as that all the forests along the banks of nearly all the hundreds of rivers in the vast Amazon system are second growth.

If Mr. Harding writes with a certain enthusiasm, and with an ear for the neatly turned phrase, the book is marred for the present reviewer by his spirit of broad-minded tolerance. Having announced in the title that he likes Brazil, he demonstrates his liking by giving many pages (all in a nicely tolerant way of course) to such things as the evil smells on an Amazon River steamer, the foolish way the steamer was run, the bad taste displayed in precisely those public monuments that the author picks out for detailed description, the lack of hot water in hotels, the hotel beds that reminded him of fakirs' spiked couches, and many similar trivia. Having told again and again how much he likes the Brazilian people, he ends his book with a rehash of the long-outmoded theory that they are enervated by the sun and spoiled by the bananas that are supposed to make work unnecessary, that shiftlessness is a national curse which does something irredeemable to people's souls.

When the author tells what others said to him, he has much in his book that is worthwhile, though scattered and disorganized; when he tells of his own thoughts and observations, his liking for Brazil seems to be that of a Southern aristocrat for the Negroes. This seems to this reviewer to be unfortunate, particularly at the present time and especially since Mr. Harding had a long talk with the Governor of Bahia about what we North Americans might do to cement closer and more friendly relations with Brazil.

E. P. H.

McGILLYCUDDY, AGENT

- - - - by Julia B. McGillycuddy

Stanford University Press, $3.00

THIS man, McGillycuddy, was a combination of M.D. and engineer, and in his early years was engaged in several government projects which made use of his talents in both of these lines. Among these he was assistant engineer and physician on the British-American Boundary Line Survey, chief engineer of the United States survey and exploration of the Black Hills, a member of the Medical Department of the U. S. Army during the Indian outbreak, and a surgeon in the cavalry from 1876 to 1879.

These activities gave him the background for a most important position as agent of the Pine Ridge Agency in South Dakota, a position he held from 1879 to 1886. Here he had charge of 9000 warlike Sioux in the largest Indian agency in the country. At the very beginning he told his Indians that, if they would select 50 full-blood Indian police to work with him, he would never call on U. S. troops, and he kept his promise.

His fearless and honest handling of Indian accounts earned for him the enmity of the insidious Indian Ring, whose trumped-up charges against him caused him to be investigated over and over again, but he was always exonerated. Had there been more men of his courage and wisdom as agents, the Indians would not have suffered the injustice that was so common on the reservations from the beginning of this period until quite recently.

In this fascinating account of frontier life, one meets such colorful characters as Custer, Buffalo Bill, Wild Bill Hickok, Calamity Jane, Red Cloud, Crazy Horse, and Sitting Bull. McGillycuddy was present at the unfortunate killing of Chief Crazy Horse, the great Sioux warrior, and the story is told in one of these chapters. Also, one of the rare accounts is that of the last great Sun Dance of the Sioux.

Te Ata.

BUTTERFLIES

- - - - - - by Ralph W. Macy and
Harold H. Shepard

University of Minnesota Press, $3.50

BUTTERFLIES, a manual for the beginner and amateur lepidopterist of the northeastern United States, will be found useful and instructive. Although not intended for the specialist, the book, nevertheless, will prove valuable as an additional reference work in which are presented important locality data and miscellaneous notes on a great many species. Our exact knowledge of the butterfly fauna of the region which the book treats best, the upper Mississippi basin, has been greatly augmented by original investigations of the authors.

An introductory section, entitled "About Butterflies," treats of a great variety of subjects concerning these favorite insects. Very readable accounts are given in such varied chapters as "Butterflies in Folklore and Primitive Life," "Coloration and Protective Mimicry," "Butterfly Odors and Sense Organs," "How to Make a Butterfly Collection," and many others.

The greater part of the book is devoted to descriptive data on the imagos and developmental stages of the 173 species discussed. The descriptions are good,—relatively brief but, nevertheless, sufficiently full for the general student. Four colored plates and a number of satisfactory black-and-white illustrations make identification of the species concerned relatively easy. Instead of a fuller pictorial expression, the authors have offered verbal keys to the species, a proceeding which is somewhat of an innovation in this group of insects but which will bring to the beginner a fuller understanding of the more fundamental characters which separate the species and genera. The nomenclature used is that of the latest check list and is for the most part now well established.

For some unaccountable reason and in spite of the claims for completeness, three species which fall well within the range of the work are not mentioned—*Erora laeta* Edw., *Incisalia lanoraieensis* Shep., and *Neonympha areolatus septentrionalis* Davis. Although the omission of any species is to be regretted, the general student will be affected little by their absence, for they are rare or local forms which seldom are seen by the average lepidopterist.

W. J. Gertsch.

GUIDE TO THE FISHES OF THE GREAT LAKES AND TRIBUTARY WATERS

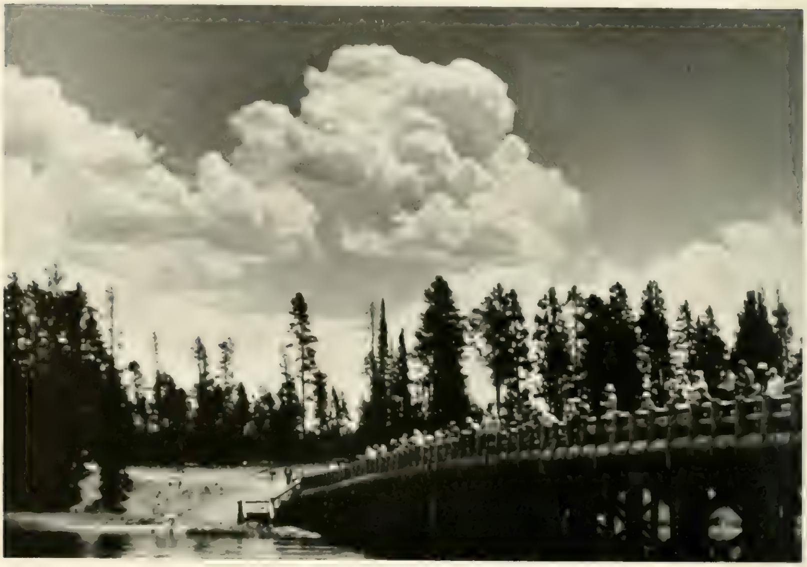
- - - - - by Carl L. Hubbs and
Karl F. Lagler

Cranbrook Institute of Science, Michigan,
$1.00

THE Cranbrook Institute of Science is to be congratulated on the publication of this little volume, perhaps the most important textbook for the classification and identification of North American fishes that has appeared for many years. The area covered is a large one, so that the 229 species and subspecies listed for it are fairly representative of our entire freshwater fish life east of the Rockies and north of the Gulf states. Whereas the book is of necessity technical, no one can expect to differentiate the numerous similar appearing and often closely related species, which characterize the American freshwater fish fauna, without mastering such technicalities as it contains. The text, and keys which make up a considerable part of same, are admirably clear and well-arranged. A map, a number of text figures, and well-chosen illustrations of some 85 different fishes are helpful.

J. T. N.

ABOVE THE BLUE HORIZON



[illegible]

CUMULUS CLOUDS—emphasized by the use of a red filter

By Charles H. Coles

[illegible]

The majestic pageant of the sky in its dramatic moments never fails to excite the enthusiasm of observers, especially if they are camera conscious. Recording these striking effects correctly adds new zest to one's picture-taking and is vitally important in many artistic compositions. Each atmospheric phenomenon has peculiarities of its own and must be dealt with accordingly.

Thunderhead clouds

Every now and then a striking cumulus cloud formation will be seen that the camera enthusiast is eager to picture. A huge storm cloud piling high into the air illuminated by the orange glow of a setting sun is as dramatic a spectacle as one could wish. Particularly if a fairly bright sky remains behind it, the exposure meter will indicate a very high light reading, which may properly be cut in half to obtain a reasonable density in the negative.

If the cloud is lighted from the side, a polarizing filter may be clipped over the lens to darken the sky behind the cloud. As far as clouds are concerned, the light from the sky is polarized to a maximum extent when the sun is at right-angles to the axis of the camera lens,—that is, to the left or right of the camera at sunset or sunrise. The effect of such a filter may be ascertained previously by looking through it at the scene to be photographed while rotating it between the fingers. When the proper effect is seen, the filter is placed on the camera lens. If rotating the filter produces no perceptible change, no advantage will be gained by using it.

If black and white film is used rather than color, a red filter may be used in place of the polarizing filter in order to increase the contrast between cloud and sky.

For sunny days with blue skies and white clouds, such as the high wispy cirrus or the cotton-like balls of cumulus, varying degrees of contrast may be obtained by use of different filters. Without any filter, orthochromatic film, such as Verichrome or Plenachrome, will hardly show a cloud in the sky except in those very few cases where the blue is exceptionally deep, as it is in the western part of the United States at high elevations. Under ordinary circumstances a light yellow filter will definitely improve cloud rendition with orthochromatic film. Deeper yellow filters can be used only with panchromatic emulsions such as Panatomic X or Superpan Supreme film. These deeper yellow filters will reduce the recording power of the blue of the sky even more than the light yellow filters and make the clouds stand out even more strongly.

How a filter works

It should be understood that a color filter has the ability to change the photographic strength of a colored object such as the blue sky, but has no effect upon white or gray objects. A yellow filter depresses the recording power of blue, thus making it show darker in a print while the clouds remain unaffected. "Unaffected" is not quite accurate, because a filter always reduces the amount of light entering the lens, regardless of the color of the light. This reduction of the light makes it necessary to open the lens somewhat wider than normal. The additional exposure occasioned by use of the filter is called the "filter factor."

The deeper the blue of the sky behind the cloud, the greater effect any yellow or red filter will have in increasing the contrast between the two. For great contrast, the red filter is used. A step further is the addition of a polarizing filter to the red filter. With the latter combination a clear blue sky well above the horizon can be reduced to a dead black in the print. Maximum contrast between clouds and sky is achieved by the use of infrared film in the camera and a red filter over the lens. Faint cirrus cloud traceries show to best advantage with this combination.

Although many yellow filters are designated "cloud filters," they should not be used with low-hanging gray clouds. Actually, the filters affect the blue sky rather than the clouds themselves; therefore blue sky is one of the essentials in the use of a cloud filter. Gray skies are not affected by a filter, so there is no advantage in using one under these conditions.

Clouds alone make interesting photographic records, but it is when they are the background for some impressive landscape or natural formation that they take on special meaning and beauty. However, the filter will also change the gray value of colored objects in the foreground. As an example, suppose an American flag is to be photographed against a deep blue sky. If a red filter is used to darken the sky, the red stripes in the flag will appear practically bleached out. A light or medium yellow filter is the deepest color that may be used without changing the appearance of the flag drastically. A polarizing filter used in addition to the yellow filter will darken the sky further without altering the color of the flag.

An instance where a deep filter actually improves both subject and sky is when photographing Indians. The deep color of the Indian's skin is lightened by a red filter, while the sky behind is darkened. Thus the sky and skin tones are brought closer together in intensity, and far greater strength is given to the final print.

Do not use a red filter indiscriminately. Were a red filter to be used on a scene in which "palefaces" appear, the skin tones would register a ghastly white.

Don't be afraid of filters. They really help make some of the most effective land- and sky-scapes. Get a few filters and use them. A red, a yellow, and possibly a polarizing filter will fill all your requirements for years to come and help you make the most of spectacular cloud effects.

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M. S. [illegible]

[illegible], N. J.

* * *

Sirs:

I consider that [illegible] and the Magazine [illegible]

Mrs. [illegible] M[illegible] K[illegible]

Baltimore, Md.

* * *

Sirs:

I wonder how many readers of NATURAL HISTORY have ever seen the animal shown in the photographs taken at Crater Lake near the southern limits of its range. It is [illegible] known as [illegible]. Perhaps its outstanding peculiarity is that it "makes hay while the sun shines," actually cutting, drying, and storing hay for its winter needs. It is described as cutting grass for its hay, but at Crater Lake there is not a great deal of grass so they use the leafy branches of wild currant a foot long, large red elderberry leaves, and nearly whole monkey flower plants, as well as certain ragweed.

Some if not all writers give the impression that grass is cut and dried right where it falls. Not so here, for everything was immediately carried down to a point near their den and spread out on the rocks to dry. Sometimes they brought such a load that all you saw was what looked like an animated little green mountain sliding down the precipitous bank.

They live in natural passageways in loose rock and require a damp lakeside situation. Conies do not hibernate but are active all winter under the deep snows common in the vicinity. This variety is known as the "dusky" cony.

To secure pictures one must be up at 5:00 A.M. and down at the station by 7:00 A.M. all set for action. At about 7:30 the conies came out on the rocks to sun themselves. Later, after viewing the trail, they would cross it and locate suitable material for hay. On the way back they were always in a hurry. By 9:30 the morning's work was ended, to be resumed from 3:00 to 4:00. The photographs were made at a distance of 26 inches. In securing them, Everett Wilcox rendered great service through his acquaintance with conies while employed at a near-by boat dock.

H. E. R[illegible]

M[illegible], N. Y.

NOTICE

Readers are encouraged to submit their best photographs of natural history subjects. Those selected for publication on this page will be paid for at [illegible] each, with full credit to the photographer. Return postage must be included.

Correction

Among Dr. [illegible]'s water fleas in the September issue, through no fault of the author, the captions at the bottom of page 7[illegible] were transposed as well as the two at the upper right-hand corner of page 79.

Bird City of t

FEW persons are familiar with the interesting bird city shown in these photographs, for its desolate location is in the Strait of Magellan, at the southern extremity of South America. The photographs are submitted by Professor V. Auer, who accompanied a Finnish expedition to the region.

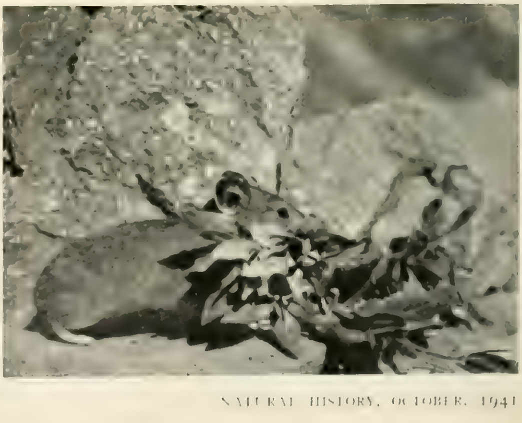
The owners of the curious volcano-shaped nests are king shags, who share the little island with sea gulls, Magellanic penguins, and sea crows, all of which depend upon fish, which they procure from the sea. At the time of nesting there is strong rivalry between the king shags and the gulls. For when the shags go to sea for fish, their thousands of nests, filled with eggs or young, offer choice pickings for the gulls. Battles between the defending shags and the aggressive gulls were observed by members of the expedition.

The life of these islets was vividly described by Sir Francis Drake and other early voyagers, and apparently it remains much the same today as it was when first viewed by white man.

LET LIVE

A Good Neighbor Policy Toward Wildlife

Recent laws passed in the Republic of Colombia inaugurate a laudable defense program for many forms of birds and animals. With exception of a restriction affecting one species of bird in a small Andean valley, there had been no laws whatever on the taking of bird life in that great country where 400 more kinds of birds are found than in Canada and the United States combined. The new decree prohibits hunting of upland plovers, robins, woodpeckers, herons, thrushes, and sparrows, and others. Ducks and geese are safe from the hunter between April 1 and November 1. Many interesting provisions were also made for the protection of four-footed creatures. The legislation was sponsored by T. Gilbert Pearson, President Emeritus of the National Association of Audubon Societies, who studied wildlife conditions in Colombia and conferred with other interested persons in the Republic



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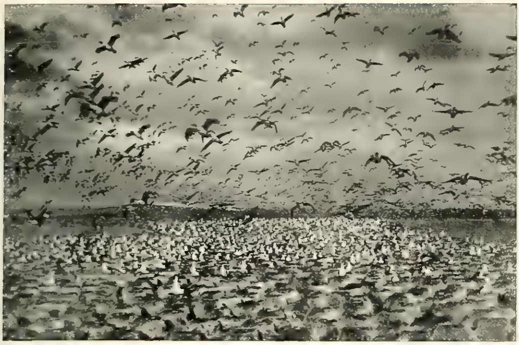
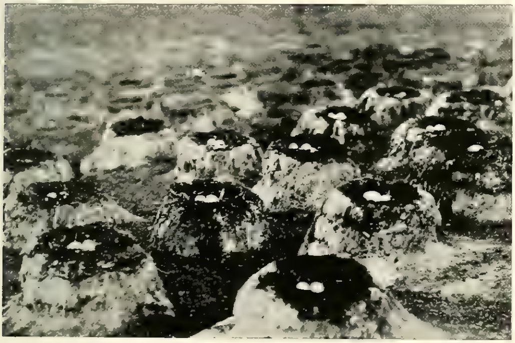
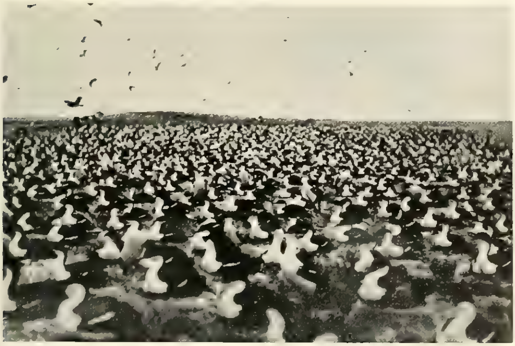


A MINUTE AGO these king shags were sitting peacefully on their nests. One rose into the air, and a second later half the colony followed suit



THE TUSSOCK-LIKE NESTS are remarkably uniform in size and shape and are made largely of the birds' excrement



WHEN the sound and the fury are over, the bird city settles into comparative calm, for king shags brood as nonchalantly as barnyard fowl

Natural History
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Above illustration—Nile River Group—Detail showing Antelope
Akeley African Hall—American Museum of Natural History

THE APPRECIATION OF GEMS

[illegible] lations between the various stones, and the [illegible]

[illegible] Market." (The travels of a diamond from [illegible]

[illegible] World." (The dramatic stories behind his- [illegible]

[illegible] Gems." (Amulets from historical times, and the evolution of the necklace.)

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if the [illegible] have been [illegible] on "A Quiz for Your Dinner" which will appear in the November issue of Junior Natural History Magazine

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LETTERS

SIRS:

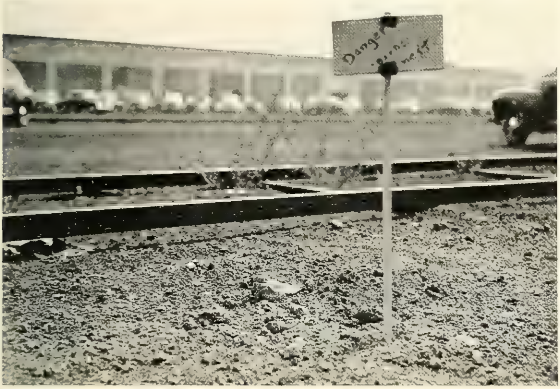
The accompanying photographs taken last spring by Mr. Charles Nash Miller show an Eastern Nighthawk nesting on a driveway within a dozen feet of hundreds of new automobiles being produced at the Nash-Kelvinator Corporation in Kenosha, Wisconsin.

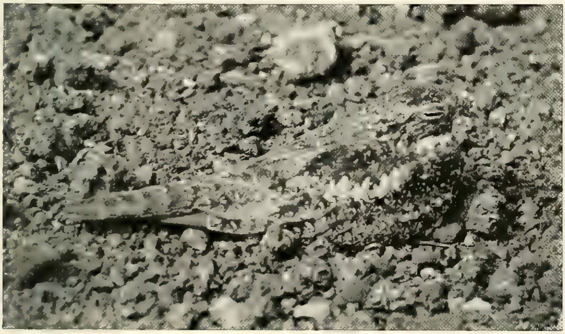
The bird rarely left the nest except to search for food, and it hatched its young apparently oblivious to these most unusual surroundings. Perhaps it felt secure because of its natural camouflage, which was highly effective here, as seen by the close-up.

ROBERT STORTZ.

Kenosha, Wis.

Photos by Charles Nash Miller





* * *

SIRS:

. . . I sometimes wonder if any copy of your instructive magazine is read by more people than is mine. After reading it myself and having numerous guests glance through it, I pass it on to my son, a physician. After he and his family have read it from cover to cover, he puts it in his waiting room where a number of patients read it. When the next copy arrives, he takes the first to the U. C. L. A., where he is on the Executive Staff, and again puts it where it is read by a large number of students, while they await an appointment with him. When it is ready to be thrown out, the man collecting them glances through it and then passes it on to the janitor, who takes it home for his children to use in their school work. So its enlightening work goes on.

(MRS. F.) HELEN C. CONDIT.

Los Angeles, Calif.

* * *

SIRS:

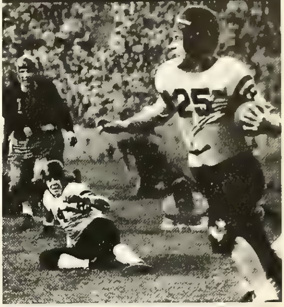
. . . I also wish to tell you that I have never enjoyed any magazine as much as I have NATURAL HISTORY. Your illustrations are exceptional.

FRANK W. SHIMER.

Mt. Vernon, N. Y.

Continued on page 254

LONGINES
the most honored watch in Football



IN FOOTBALL, the official timing watch for most of the leading colleges is Longines. More than 100 colleges including Army, Cornell, Dartmouth, Navy, Texas A & M., Washington and Yale chose Longines as official football timing watch for all games in 1940 and again in 1941. Longines is also official watch for the National Professional Football League.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Roy Chapman Andrews, Sc.D., Director

VOLUME XLVIII—No. 4 ★ ★ ★ ★ ★ ★ **NOVEMBER, 1941**

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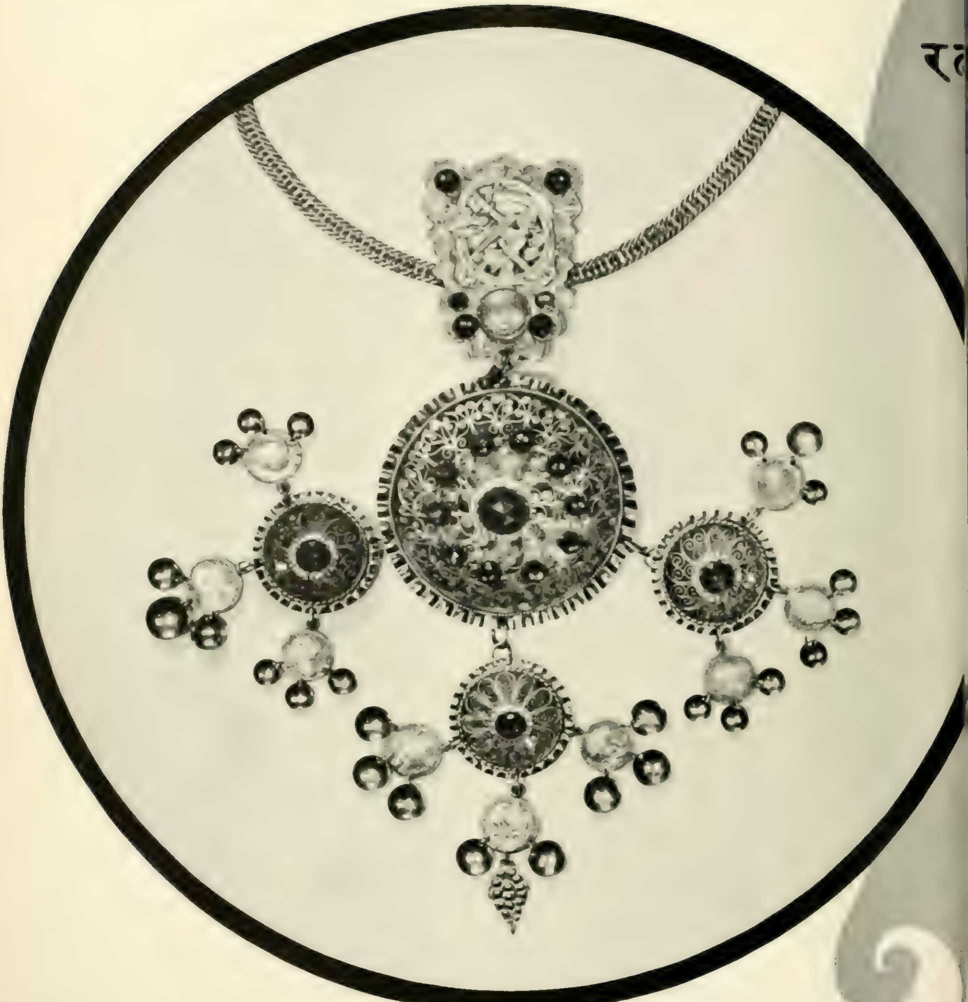

Necklace of a Norwegian bride, silver and heavily gold-plated. The top piece depicts St. George slaying the dragon, and under him a coin shows King Frederick III of Norway and Denmark (1609). Nine other ancient coins of gold boast the heads of former kings. One is Frederick IV; the others are too worn to identify. The twenty-six little gold disks catch the light and tremble with every movement or even with the rise and fall of the bride's bosom as she breathes

เครื่องเพ็ชรพลอย

貴金屬

JEWELRY

ROUND THE WORLD

By W. R. LEIGH

All photos by Thane Bierwert

To appreciate the virility of a fine piece of Navaho silver, the sophistication in an intricate East Indian necklace, or the symbolism worked into a wedding crown from Norway, one must see these fine things daily, observe, handle, compare them. To understand their beauty and craftsmanship is to establish for one's self standards of taste, yardsticks to measure all artistry. Even as the sensitive finger tips touch the secret of precious crystal, jade, or turquoise, the eye and memory so trained are armed against exploitation, safe from deception by the tawdry knickknacks foisted upon the gullible in the name of art.

Only so can the young be lifted out of the commonplace that surrounds them in a machine-made age and be freed from the danger of clinging through familiarity to what is definitely unlovely. Contact with true art alone can teach them never to confuse what is merely bizarre with inspired originality.

Following this reasoning, we have circled the globe so as to be able to surround the young men and women who come to be taught design at the Traphagen School with an atmosphere in which unconscious absorption of good taste is possible and in which they must inevitably discard the imitative, the meretricious, and the false.

We have brought from all parts of the world some of man's most glamorous dreams of art, objects that combine beauty and fine craftsmanship and reflect skills that have been fostered by generations of the privileged in lands other than our own. Only a few of the treasures Fate has dropped in our lap can be shown here. These and hundreds of others form a cultural background for our work. Thus the wretched monstrosities that crowd the shops and struggle to break down our artistic morale are exposed to comparison with true beauty, and a new conception of the designer's art is attained. So far as possible we share with our pupils something of the thrill we found in discovering and collecting these things, and as the feeling for artistic quality is acquired, it becomes the foundation for creative work.

NAVAHO
ZUNI
CHILE
BOLIVIA
ARGENTINA
PANAMA
ZANZIBAR
SOMALILAND
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SIAM
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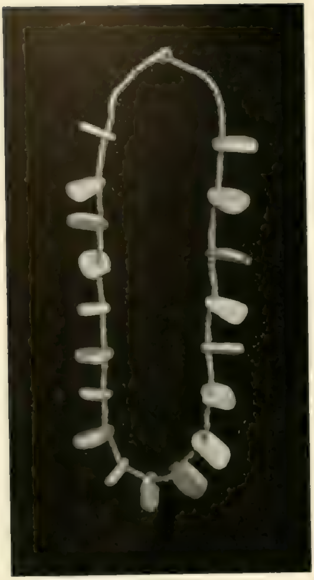
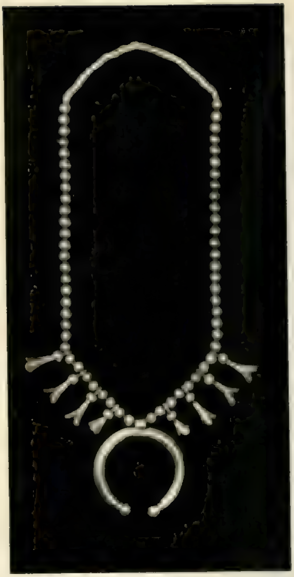


(Left) ONCE it would have bought a bride, now it might buy two, as turquoise of this size and quality is hard to find. This is one of the most primitive types of Navaho necklace, with wampum separating choice pieces of sky blue stone



(Right) ONE OF THE RARE, early silver necklaces: a lucky find, indeed. The tiny hands on the encircling arm are never seen on later pieces. The origin of this form is lost in antiquity. Early Spanish bridles bore a similar crescent that can be traced to Moorish and Arab charms, which in turn resemble an ancient Roman harness ornament

OUR American Indian collection began in a haphazard way, but not just as a hobby, or for personal use. Jewelry is expensive and almost every piece had to serve double duty—as studio property for my Americana paintings of cowboys and Indians, and for the authentic costumes which my wife, Ethel Traphagen, uses in her fashion school. Often the pieces served us both, not once but many times. The collection has proved an unexpected source of pleasure and illumination to each of us.

We learned what to look for so as not to be deceived. Indians call silver "the metal of the moon." We learned that there are no authentic records of the Navahos making silver jewelry before 1850. One story said that Indians had been stolen as children and sold into slavery in Mexico, where they learned the craft, and afterwards escaped back to their own people. Other sources stated that the early traders brought their smiths with them into what is now New Mexico and Arizona, and that the Indians helping them grew skillful in the working of iron and silver. We heard gruesome stories, too, of murdered Mexicans whose silver trappings enabled the Indians to increase their knowledge.

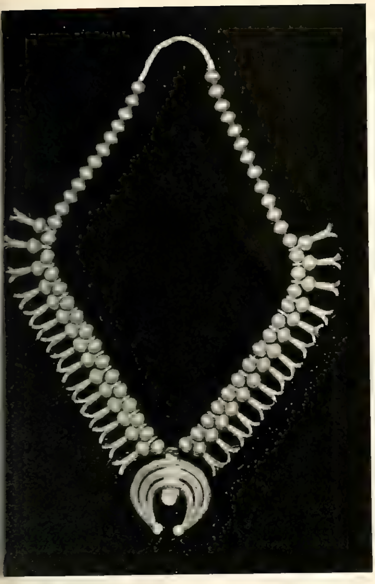
We learned that the different kinds of silver used in Navaho jewelry help to determine the date and value of a piece. American money secured from the soldiers at Fort Defiance and Fort Wingate went into many of the early bangles. Previously fashioned from brass and copper wire, such bangles had been used by the Indians for gambling during their confinement at Fort Sumner, New Mexico. The American silver is rather bluish in hue and takes a higher, harder polish than the more yellowish Mexican. Mexican silver became popular after 1871 when pesos were furnished for the first time by Chah-leh Sani (Old Charley), who operated the first trading post in Navaho country.

We knew that turquoise had long been considered sacred in the eyes of the Navahos, but it remained for our Indian guide, "Gray Eyes," in the Canyon de Chelly, to tell us that all Navahos wear at least one bit of turquoise, even if it be but a bead tied in the hair. This affords divine protection, so that "the lightning will not strike nor the rattlesnake bite." Turquoise is said to have first been used in a silver setting in 1880, and not frequently until after 1900.

We learned to distinguish the clear blue color which appeals most to the Indian, and for which he will trade a horse. It is found to this day in the mine at Cerrillos, not far from Santa Fe, from which the first turquoise came long ere the conquistadors startled the painted desert out of its deep silence with the tread of a new civilization.

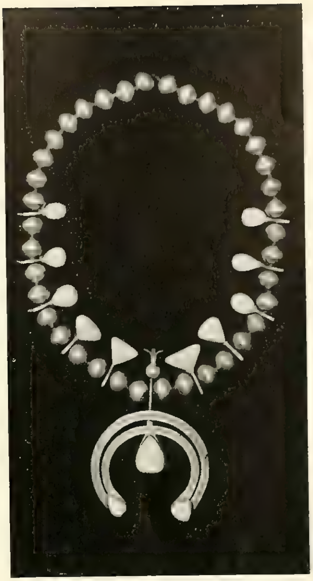
Not only color but hardness determines the grade of turquoise. Softer stones soon turn green with absorption of oil from the skin. The "Spider Web" from Nevada, much prized by Indians and collectors alike, is deep blue with black lines through it, and is becoming rare. There is an attractive mottled green turquoise from the vicinity of Tuba City; and the source of a pale robin's-egg-blue stone is known only to the Indian. One must beware of the low-grade dyed stone and the so-called "Persian turquoise," which are said to be imported from Tibet.

The polish of these stones also tells a story. The Indian does not get the high gloss that is imparted by the professional lapidary, and one need not be a connoisseur to detect the low-grade turquoise sold by unscrupulous American dealers, or the glass imitation turquoise beads that have flooded the Southwest from Czechoslovakia.

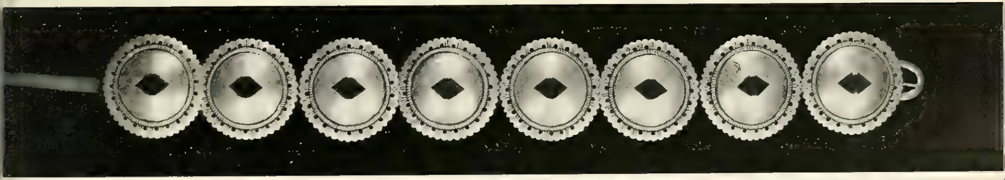


(Left) Our necklace is becoming more sophisticated, with three protective arms and a turquoise button in place of each hand. A symbolic "hogan," or house, now supplies something for the arms to guard, especially as it, too, is set with sacred turquoise. The "squash blossom," Hopi symbol of fertility, may be derived from the Spanish heraldic pomegranate, emblematic of Grenada, or from the small flower inside our sunflower's petal-ring

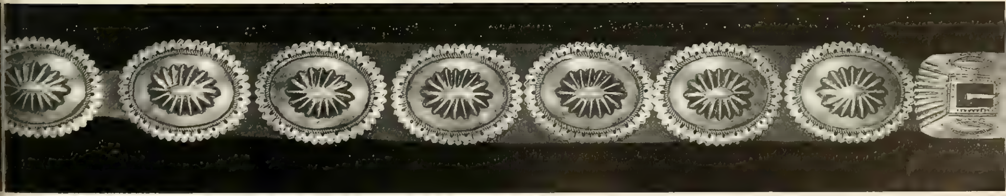
(Right) Genius is usually impetuous; here the artist chose to use only one "squash blossom," but added ten choice pieces of sky-blue turquoise to fill the vacancy. The photograph shows these turned in, but they hang outward on the owner's neck. The crowning glory of this necklace is the decorated "arms of God," embracing a superb massive "hogan" of turquoise



(Below) An old belt, rare today. Here you feel the Navaho's spirit, pure, unadulterated. His love of the beautiful "metal of the moon" prompted him to deck out all his wives—he may have had as many as four—and all his boys and girls to boot. As in all belts made before the Indians learned to weld silver, the strap is threaded through slits in the silver



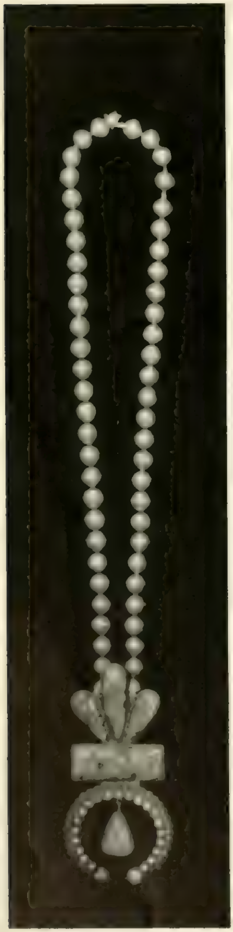
(Below) Time has brought skill: welding has been discovered! The narrow strap of the old-fashioned belt was uncomfortable after a long day's ride. So when silver loops could be fastened to the backs of the silver pieces, the band widened. Invention, forever active, has also here evolved oval instead of circular *conchas,* so-called from the Spanish word for "shell." This belt weighs over three pounds and proclaims the Navaho's right to be classed as a finished artist. Today, instead of coins, traders supply the Navaho smith with slab-silver

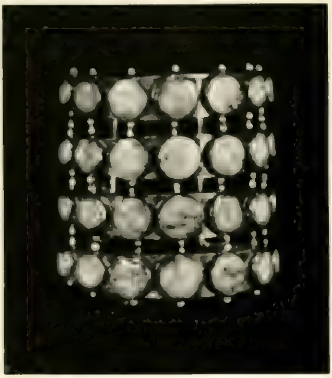


T[illegible] turquoise is preferred to the rounded [illegible] works naked to the waist because of the heat, which is increased by the [illegible] band he wears. Nothing can distract [illegible] on earth.

Here it is, a challenge to the proudest and the most adroit designers of the world. Fifty-eight silver beads support a pendant that shows all the Zuni's [illegible] and red abalone. In it are seen the skies of New Mexico; the sunrise over [illegible] noonday blue of the firmament, and the ardent red of the unforgettable sunset.

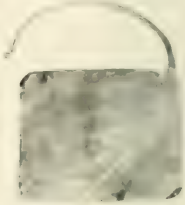
[illegible] ones had crosses alternating with the beads. Previously the Indian jewelry was made entirely by the men, but to-[illegible] engaged in the craft. The legends of the Zuni and their pantheon of gods, translated by Frank H. Cushing, constitutes a classic.



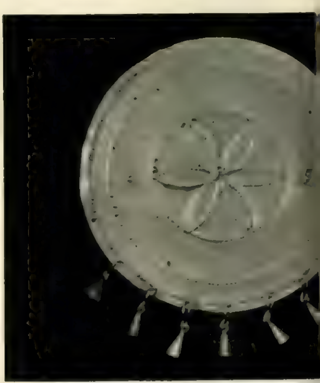


(Above) A ZUNI BRIDE'S BRACELET. Mexican dollars provided the silver for these four bands, fastened together by lateral binders and set with 28 pieces of turquoise. No two Zuni bracelets are exactly alike; the artists work like the smiths of India. The happy result is that we have here in America a source of original art work, expressing individuality unmarred by standardization

(Left) A ZUNI BRIDE'S NECKLACE. Fifty-eight silver beads support a marvelous turquoise matrix flanked by two pieces of red abalone shell, with a grand rectangle of blue matrix beneath. The ornamented arms of the crescent embrace the symbolic home, a triangle of unsurpassed turquoise. Such are the dreams of the simple Zuni artist, who sits in an adobe dwelling surrounded by his babies and their one or two mothers, in the shadow of his sacred mountain, Toy Yoliny



(Above) A FIVE-INCH SILVER EARRING typical of Chile's Araucanian art. These pendants are calculated to anchor the attention, for the idea of making one's self inconspicuous is not included in the philosophy of the Araucanian belle, who loves to be stared at



COLD WINDS DESCEND upon the Araucanians in their native forests on the western slopes of the Andes, so they wear thick blankets of vicuña or guanaco. And to keep these in place, they use long pins like the one above. Complete with design of Spanish origin, this fastener is intended not merely to hold the clothes on but to "knock one's eye out"

IN the Araucanian Indian country of Chile, the conductor called out, "Temuco! Three minutes to wait."

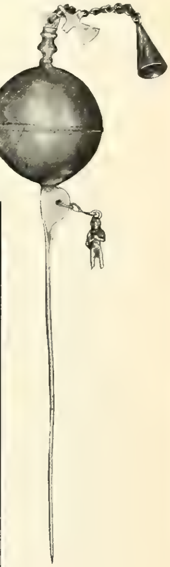
"Can I do anything in three minutes?" I said to myself. Scarcely was the thought formed when my eyes alighted on a man on the platform with a basket and something in his hands. He was alone, so I bounded to the station platform and made for him.

What he had in his hands was native tobacco. I glanced at his basket and beheld a queer jumble of silver objects—just what I was looking for. As I tipped the basket, the objects clattered to the concrete, and I saw the strangest assortment of savage ornaments I have ever seen. I seized the largest, the only complete piece. There was just time to show it to my wife, pay for it, and hop on the train. The necklace was a rare find, as I later learned.

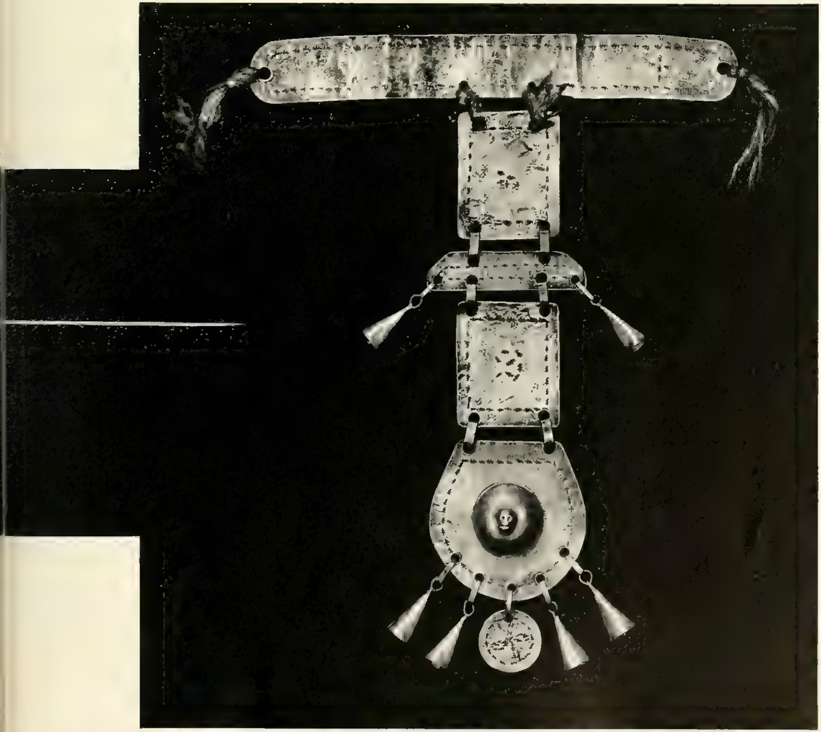
The name Araucanian means "rebel" in the Inca language. These people, who call themselves "Mapuches," originally wore the skins of the guanaco, alpaca, and llama. They were never subjugated by the Incas, but they learned weaving and silversmithing from them.

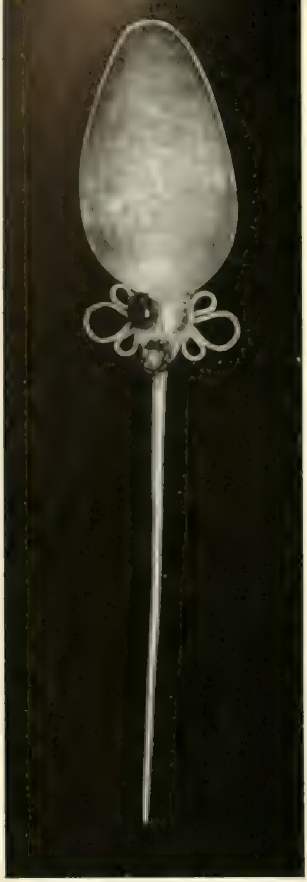
The massive silver ornaments they wear are widely varied but always reveal Inca influence. Our necklace weighs one pound, and its bottom pendant, nearly four inches wide, bears the figure of a skull, a favorite emblem with the Incas. The surviving art of these people shows the strange way in which the savage mind combines the simple with the bizarre, the hideous with the beautiful, whimsically and naïvely jumbled. It gives us a glimpse of the primitive artist as a bold yet charming creator, working toward magnificent original goals.

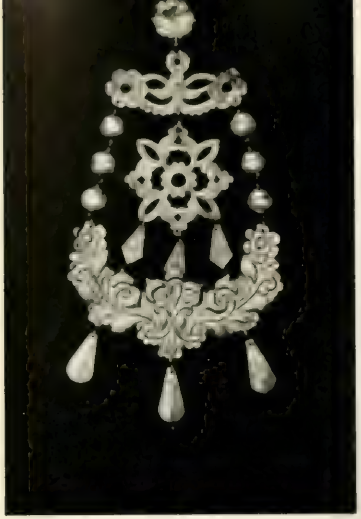
***(Below)* MODERN HERITAGE of the Incas: a fourteen and one-half inch necklace weighing one pound, made by the Araucanian Indians of Chile. The bells have no clappers but tinkle together gently when the wearer walks. The silver strap at top was bent around the throat. Note the raised skull, doubtless a relic of the ancient day when human sacrifice and the impulse toward art flourished side by side**



***(Right)* A GLOBE the size of a large orange decorates this Araucanian pin, and an eleven-inch needle makes it an effective one. The praying figure shows Christian influence, but the globe is probably the oldest form. Purer silver was used in these older pieces than today**





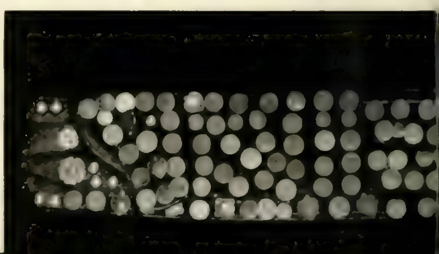


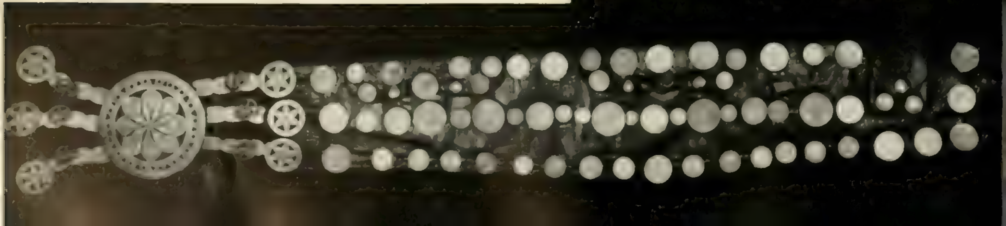
(Above) SCOFFING AT DISCOMFORT, the full-blooded Indian belles of Bolivia will load themselves with awkward and expensive trappings as willingly as women anywhere in the world. This is an eleven-inch silver earring, designed to flash restlessly with every slightest movement of the head. The women also wore elaborate gold ones, but no offer of money would tempt them to part with them, and the shops held out no hope of securing any. The design is more characteristic of Spanish Colonial times than the present

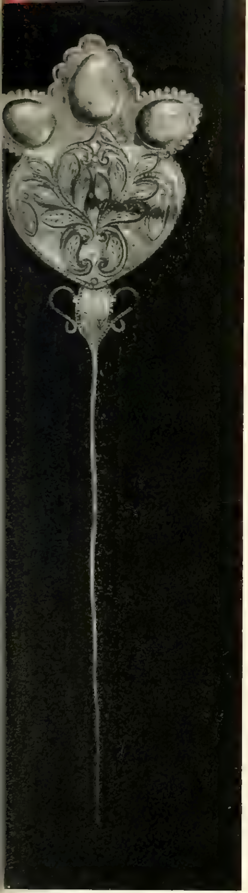
(Left) THE NINE-INCH NEEDLE of this huge silver spoon will go through several thicknesses of blanket. Of Bolivian origin, it shows characteristically greater Spanish influence than the Araucanian jewelry. To embellish the pin, the artist chose a topaz and two garnets, one of which has been lost

(Right) THE ORNAMENTAL HEADPIECE of this pin from Bolivia is six and one-quarter inches wide, and the needle thirteen and one-quarter inches long. The ornamentation is all borrowed from Spain

(Right) MASCULINE ADORNMENT reaches a high point in the Argentine cowboy, or Gaucho. Originally little more than a wage-slave, he rose to fame as Argentina's beef industry grew, and evolved a costume. His mentality, like his blood, was often an even mixture of white and Indian, and his costume is indicative. He was a rough-and-ready dandy and heart-smasher, handy with the lasso, the bola, revolver, and knife. His picturesque era is becoming a thing of the past. The 128 pieces of silver on this belt are from all over the world and include some religious medals. Note the holster



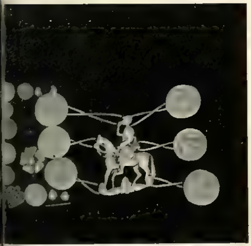




In the isthmus of Panama, a little grizzled man with a German accent, alone in a tiny shop, held out in his tremulous hand a living thing in gold. "It is a big price, oh yes! But it is the best one I have ever seen, except the much larger one the government presented to Charles Lindbergh." It had been excavated in Chiriquí Province, North Panama,—a thunderbird of pure gold, very heavy and not less than a thousand years old *(illustration at right)*.

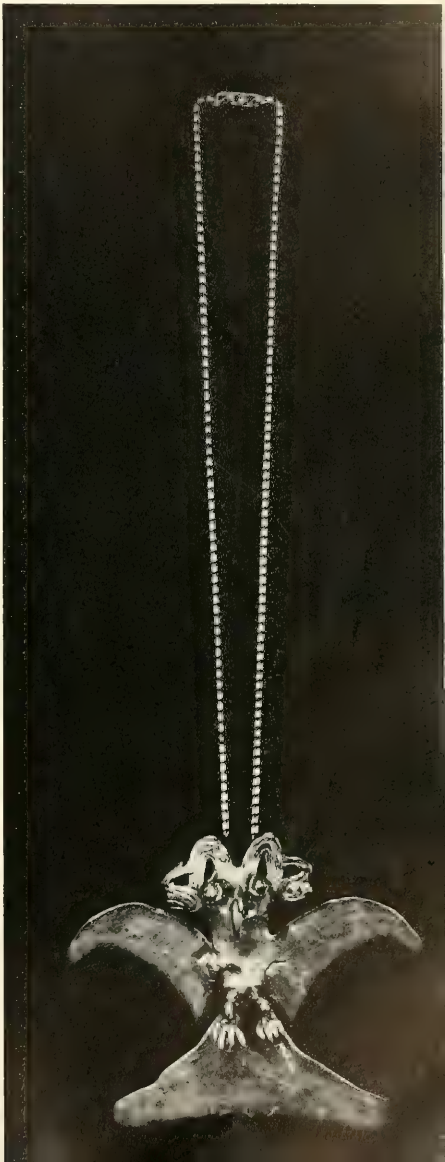
The sources of these relics are often known only to the Indians, who—in violation of the laws, so we were told—dig in ruins lost in the depths of the tangled forest. In such ways rare pieces of art drift to the haunts of civilization, as messengers from a fabulous past, echoing extinct grandeur and primitive genius. If this golden bird could speak, how it could solve for us riddles which otherwise will forever remain in the twilight borderland between legend and history.

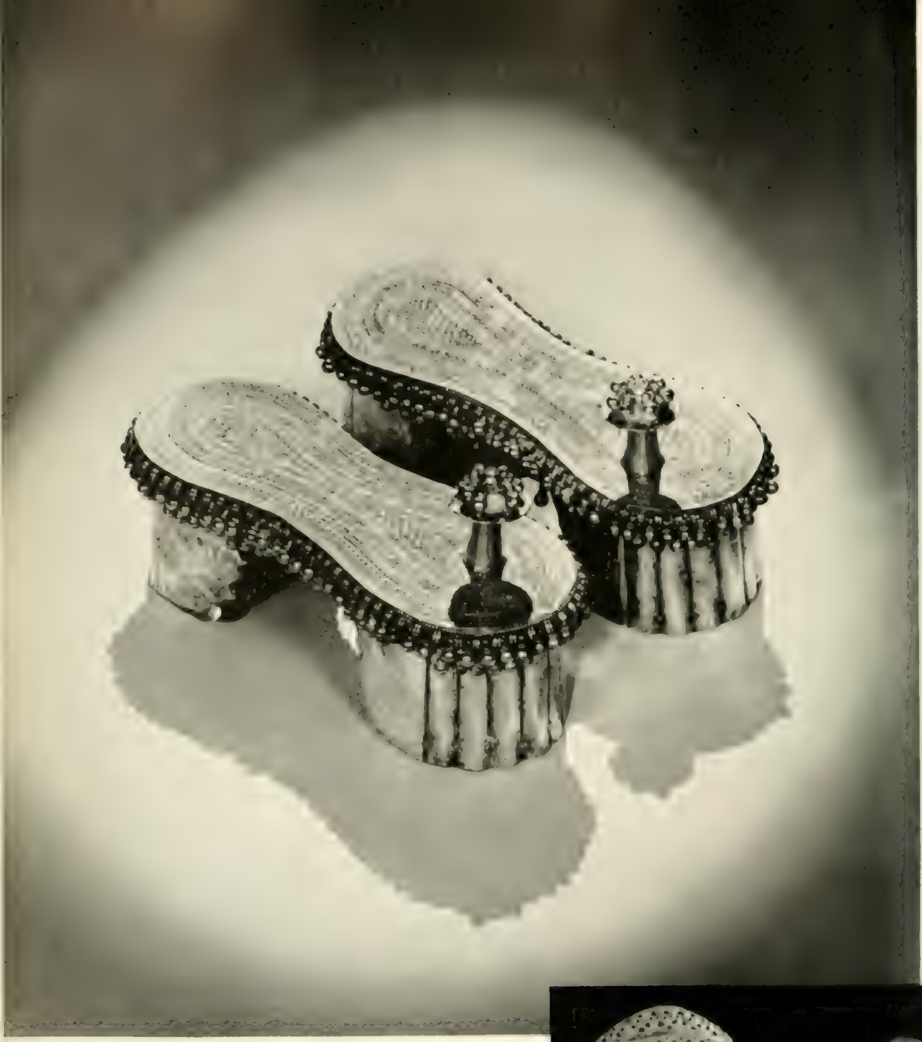
Bloody duels were fought over the division of cattle and the attentions of the fairer sex with Gaucho knives like this one. Its metal is engraved with crude drawings representing almost everything from a sunrise to a haystack. It is dated 1816. In the dance halls the Gaucho is not safe without his knife, and he is a wizard in the use of it



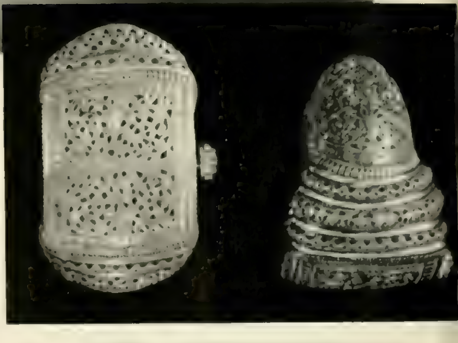
(Left) Some of the coins on this belt are old and rare, four of them dating from pirate days when crude pieces of silver bullion, known as "pieces of eight," without regular shape, were stamped and passed as money. The elaborate buckle is of heavy silver, and each small wheel has a copper center

(Below) Thunderbird in gold: a three and one-quarter inch pendant from Panama, very heavy and not less than 1000 years old. The chain, added later, is of gold and of American colonial origin





(*Above*) THE CHOPINES of a sultana of Zanzibar. One would go far to find the equal of these raised slippers of silver and gold, whose tiny bells once tinkled in a sultan's palatial harem, just off the east coast of Africa. Red lacquer underneath is a relic of Chinese influence in Zanzibar



A SYMBOL OF SLAVERY became an object of adornment when the chain connecting the ankles was abandoned. The eternal urge for feminine adornment called forth the highest artistry of the Arab and East Indian silversmiths. A proud Arab lady wore these anklets willingly, though each one weighs a pound and a half. (*Front and side views*)

Barghash-bin Said, one of the sultans of Zanzibar, was something of a "gay dog." He built a lordly pleasure palace where, according to rumor, a hundred or more concubines guarded by eunuchs dwelt in magnificence and idleness, on this colorful island off the east coast of Africa.

The demise of this potentate brought swift and radical changes. The princely harem mysteriously burned to the ground almost immediately. The next ruler was adamant to all appeals of the aging beauties, and a wholesale pawning of their valuables began, as they perforce returned to a modest life.

We visited the sad ruins of the once fairy realm. The mango trees were as superb as ever, but the gardens, fountains, and ornamental bridges were abandoned to the elements. The overgrown foundations of the palace showed gaping tunnels leading into suspicious obscurity and twilight networks of masonry. Not unwillingly, we entered a tunnel and groped our way from chamber to chamber. Bats as big as pigeons clung to the ceilings and flopped above our heads.

The pawned possessions of the unfortunate ladies were scattered all over Zanzibar; every merchant seemed anxious to acquire some. Upon our arrival only the costliest objects remained. Humble little "holes in the wall" yielded treasures, covered with dust and dirt, which only the initiated could spot.

One was a pair of raised slippers, or chopines, of silver and gold, once the property of a sultana, which are shown at left. Each platform is of elaborate chased silver, edged with little silver bells to frighten demons and warn the master that the wearer is approaching. The toe-post is of gold, with gold bells. Few of us realize that chopines were once worn in London and Paris. Shakespeare speaks of them in *Hamlet*. Nor is it generally known that a good many hundred years ago a Chinese junk was wrecked off the coast of Lamu, an island near Zanzibar, leaving an influence that can be seen today.

To prevent purchased damsels from running away from loosely guarded harems in the old days, hobbles were put on their poor little ankles, connected by a short chain which made running impossible. To make the horrible things more tolerable, feminine love of adornment took a hand. Grace they could never have, yet something beautiful could be made of a necessity. So gradually a rivalry grew up as to who could possess the most attractive hobbles.

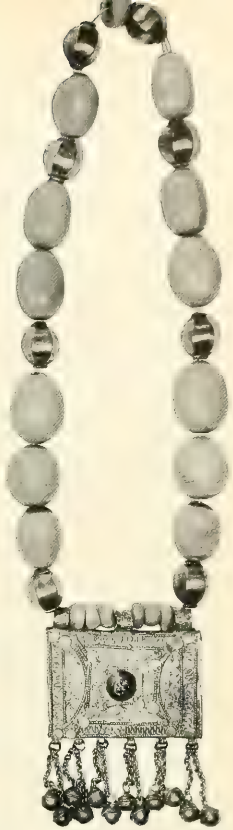
Thus in time the hobbles changed from objects of humiliation to fashionable and cherished adornments. When the harems became better guarded, the chain connecting the anklets disappeared, and the hobbles evolved into anklets. Ah! What a pitiful tale of pathos and degradation, yet art has glossed all this over so that we admire the artistic display and forget the rest.

Having become emblems of rank, the finest anklets had the most exquisite art of the Somali and East Indian silversmiths lavished upon them. The costliest were of heavy silver, but hollow to prevent their being burdensome *(at left)*. The cheaper ones are of thinner silver but are filled with pitch to make them seem heavy and expensive.

Of all the amber in the world, none can surpass the glorious semitransparent, wave-streaked amber of Madagascar. It is of the most luscious golden color, worked into beads the size of small hens' eggs. Madagascar is the fabulous realm to which Sindbad the Sailor journeyed during the heyday of Arab civilization. And here, in bygone ages, grew some of the rarest of the resinous trees which exuded gums that have come down to us fossilized as amber.

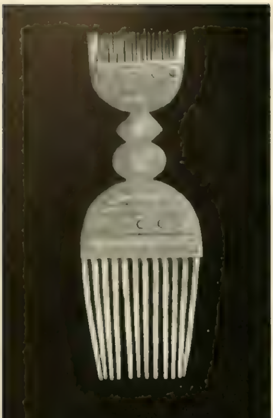
The silver prayer box above was pawned by a favorite wife of a former sultan, but when it fell into our hands, half of the necklace was missing. Then began the search for the other half. Six honey-amber and four silver beads had to be matched. Not a shop in Zanzibar was overlooked. Here we found two amber beads strung on a piece of banana leaf and hung on a nail in the wall; there two silver beads were discovered unexpectedly in a shop window. Finally our prayer box necklace was complete.

The choice silver box still contains prayers from the Koran, written on parchment. Ah! had we but the story of that necklace, what a tale it might unfold!

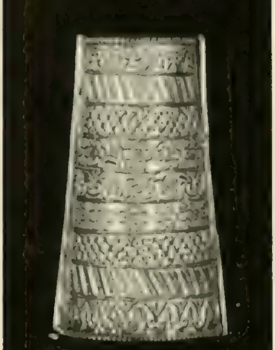


(*Above*) A lavish Somali prayer box, suspended from a necklace of the finest honey-amber from Madagascar, interspersed with silver beads. Prayers from the Koran still reside in the silver box, protected from evil spirits by the jingling bells beneath it

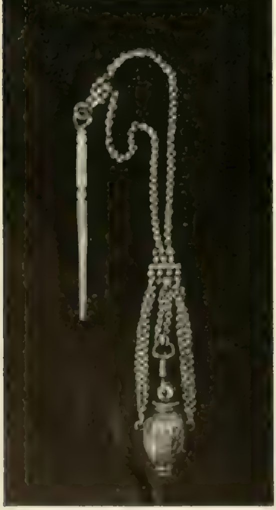
(*Right*) A whole cluster of tiny silver bells raises the homely hairpin to an object of artistic beauty in the boudoir of the fanciful Arab belle



(Left) ONCE THE PRIDE of a sultana, this comb with gold and silver zones contrasting beautifully, shows some of the finest craftsmanship to be found in Arab art. The same general form in wood is used in many parts of Africa. This was one of the objects that had been in pawn for years in Zanzibar. It was found by the author's ingenious guide, George Washington Number 23, who learned from the old Arab who sold it that he had inherited the comb from his father, along with other treasures of the late sultana



(Left) AGAINST the satin-brown skin of an Arab belle, this highly polished silver armlet illustrates the Oriental designer's persistent aim to produce a striking color effect. Nine zones appear in each armlet. The central is the pineapple, between bands exhibiting the pomegranate flower; the rest are conventional. The hand-wrought design lends a charm that no machine can impart



(Left) ARAB "COMPACT." In looking at the ancient Egyptian frescoes, many take note of the peculiarly elongated eyes of the people, but few realize that it is an artificial effect, gained by the use of liquefied charcoal. The same fashion, six or eight thousand years old, prevails today, and no Arab lady's costume is complete without the kohl-container and applicator. The stopper of this one screws in. When out of use, the stick is thrust behind the belt

IN the Salisbury Hotel in Nairobi there appeared at our door, which opened directly upon a large sun-drenched court, a tall, slender aristocratic brown man. He was not of these parts. He had palm-leaf mats for sale.

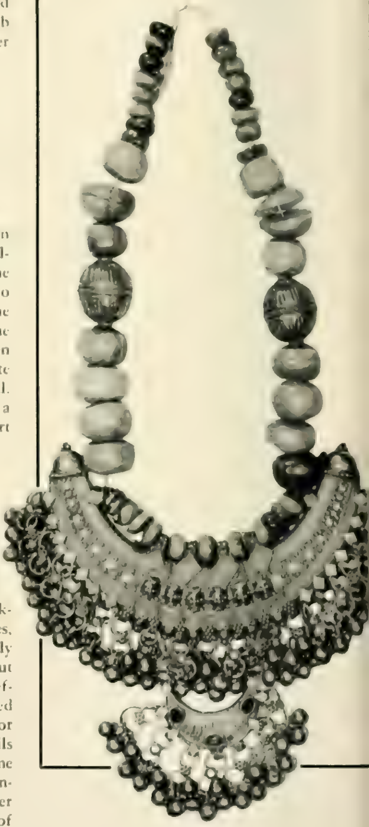
"We have little use for such things," I said after we had bought a few.

"What are you interested in?" he asked.

"Amber, silver, gold objects," I replied.

"Oh," he said. "I will return tomorrow."

About the same hour the next day he appeared and exhibited before our astonished eyes the most magnificent silver and amber necklace we had ever



seen,—not perhaps the most expensive, but the most artistic. It was an epic poem of feminine adornment, a masterpiece sprung from the brain of a consummate creative artist, unshackled by any inhibitions and boldly expressing a romance and glamour such as we Occidentals are rarely capable of.

"What is this?" I exclaimed.

As soon as I glimpsed it an inner voice cried out, "This you must have, no matter what the cost." My wife and I were equally fascinated, unable to tear our eyes from it. The necklace was massive, rich, gorgeously irregular, barbaric.

It was a necklace for the queen of a harem, with clusters of little ornamental bells to scare away evil spirits and to notify the lord of the approach of his chief wife. Two of the large beads were held together by silver wire, and we discovered curious red-brown flecks in the depressions of the design covering the large crescent.

We had purchased in the bookshop of Nairobi *The Mad Mullah of Somaliland*—a life of Seyyid Mohammed Abdulla Hassan. On the jacket there was a portrait, frankly fanciful, of that renowned despot of British Somaliland who had kept the English at bay for 21 years. I had been reading about this renegade, whom no white man had ever seen, when the merchant appeared with the necklace.

He was looking at the picture on the cover, and he said, "That isn't anything like him."

"How do you know?" I countered.

"I have seen him."

"Where?"

But my man became evasive, distrustful. I looked at his hands, which were slender, beautiful, and had never done manual labor. "Who can this be?" I asked myself. We have since believed that he was a son of the Mad Mullah.

"What is your name?" I asked.

"Mohammed Hassan," he replied.

I felt him closing up on me and I repeated my original question, "What is this?"

"That," he answered, "is a necklace worn by the wife of the Mad Mullah." We gasped. "It was purchased in Aden by the mother of the bride as a wedding present. She, the bride, gave it to her younger sister when the latter married a neighboring chief."

I already knew from the book that in British Somaliland cattle-raising was the occupation of the dominant caste. They were cattle kings, near counterparts of our Texas variety, and like them, got into frequent quarrels over the wandering herds.

"And how did these two beads become split?" I asked.

"By backhand stroke of a saber. It cut off the head of the first wife of the neighboring chief, during the sack of a village," came the unemotional reply.

"She was wearing this necklace?"

"Yes."

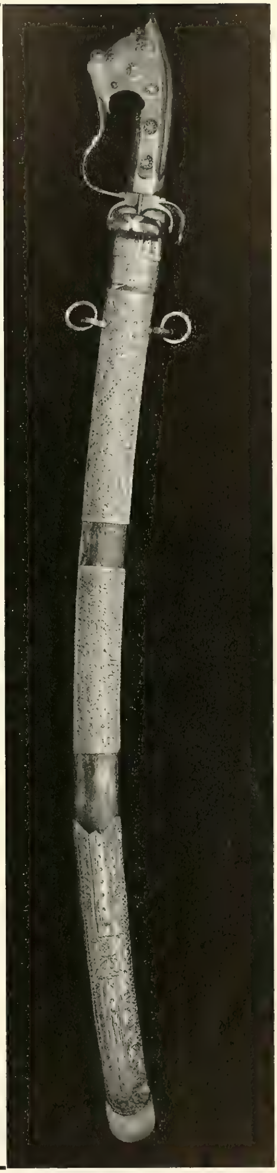
"And what are the curious flecks down in these interstices?"

"Blood," he replied.

BESIDES this necklace, the man, whom I now knew to be a Somali, showed us a saber in a beautiful silver scabbard on which were engraved inscriptions from the Koran. It had a wonderful handle, but when I fitted my hand into it, I found it small. Seeing my trouble, the man took hold and drew the weapon from its scabbard. His hand fitted so perfectly that the suggestion that he was its owner was inescapable.

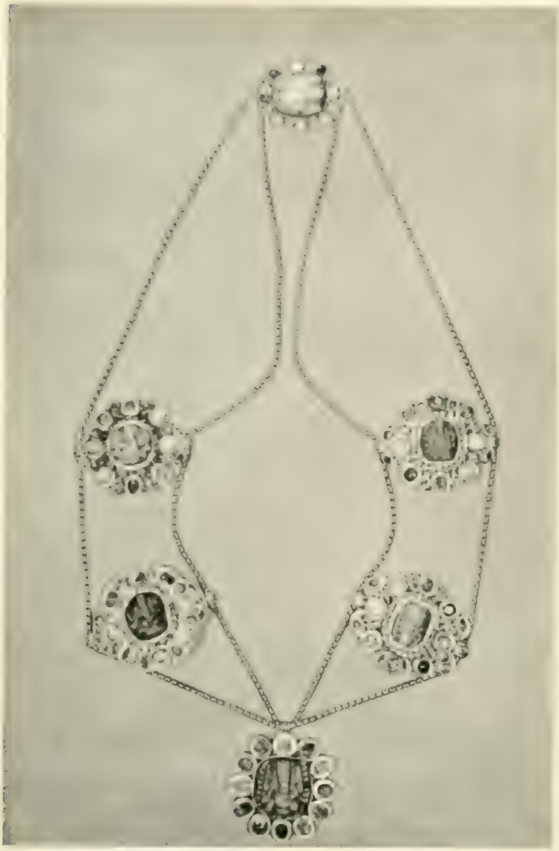
That evening we showed the necklace to Mr. and Mrs. G. Lister Carlisle, Jr., who were sponsoring the safari for the Lion Group for the African Hall of the American Museum of Natural History. The following day Mrs. Carlisle bought the saber, and later presented it to us. Upon re-examination we discovered on the scabbard, crudely engraved in the silver, the name "Mohammed Hassan."

Circumstantial evidence suggests that this man, from who we afterwards got a written history of the necklace, was an officer in the army of the Mad Mullah. Perhaps it was he who dealt the blow and split the two beads, with the very weapon which bore the name "Mohammed Hassan."



(Left) **NECKLACE OF THE MAD MULLAH'S WIFE: the silver and amber Somali piece whose unique story Mr. Leigh tells above**

SOMALI SABER with blade of Damascus steel, the weapon whose past may be linked with the ill-fated necklace opposite



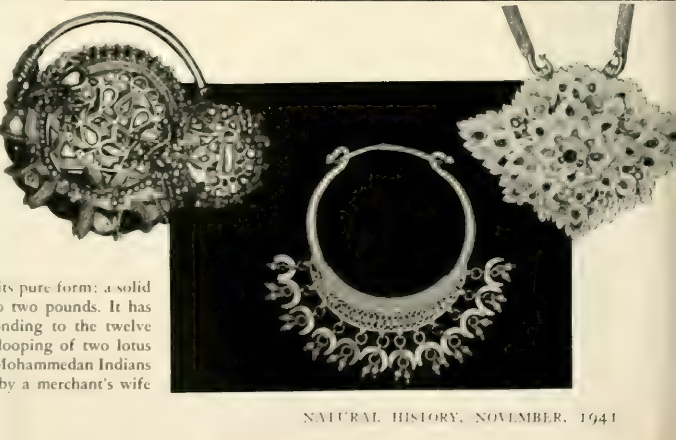
A marvelous example of fourteenth century East Indian art is the necklace shown at left. It was originally a votive offering in a Hindu temple, where it no doubt remained for many years. Then it was presented by some government potentate to a prince Galitzine, Minister Plenipotentiary of Russia at the Indian Court.

During Philip IV's time, Velasquez painted the portrait of the Dowager Princess Galitzine probably because of her exceptional beauty. The portrait, in which she wears this necklace, is said to have hung prior to the Revolution in the Hermitage Gallery in St. Petersburg. In 1893 the necklace came into the possession of Madame Shadrin, wife of the last governor of St. Petersburg, who was herself born Princess Galitzine.

Emeralds, rubies, pearls, sapphires, moonstones, topazes, amethysts, mother-of-pearl, aquamarines, garnets, lapis lazuli, cat's eyes, turquoise matrix, and

(Left) A distinguished example of fourteent century East Indian art: the necklace of th Princess Galitzine. Fourteen different kinds gems surround the six coral disks in heavy gol settings. The largest represents the elephan headed god Ganesa, who is invoked at the b ginning of every Indian book or epic poe Golden chains replace the original Orient cords. The lady who wears this necklace ma scorn the endless duplication of mediocrity i the Machine Age, for she knows that there not another one like it in the world

The expression "nose ring," strikes a decidedly discordant chord in the Occidental, but esthetic value belongs in the realm of opinion and custom. From Bombay, the example in gold at right is set with many precious stones and weighs a quarter of a pound. It would certainly interfere with kissing, but kissing is unknown in the East

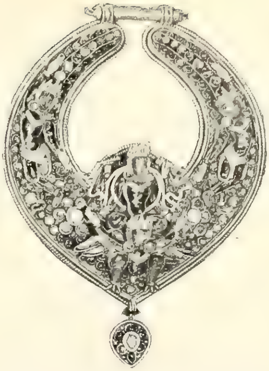


(Right) East Indian design in its pure form: a solid silver necklace weighing close to two pounds. It has twelve crescent moons, corresponding to the twelve months, and is fastened by the looping of two lotus buds. It is a typical form among Mohammedan Indians and Arabs, and would be worn by a merchant's wife

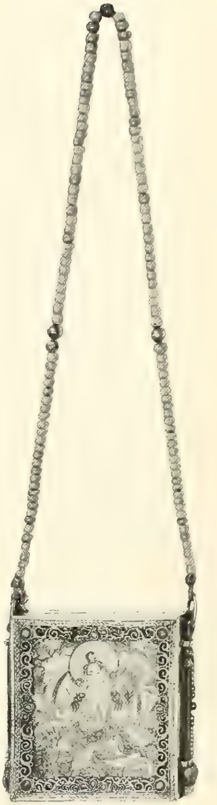
diamonds, surround the six circular pieces, no two of which are exactly alike. In this country such a design would be thrown out by our leading makers of rare jewelry,—uniformity is demanded. But in India our god of Uniformity is flouted and despised, while the god Balance is heeded with due reverence.

We can reconstruct the birth of this masterpiece. A raja's wife is seated with some of her ladies about an onyx table on which is a huge pile of precious objects: much gold and silver, cut and uncut gems, brooches, bracelets—a vast accumulation handed down through the generations for, perhaps, 500 years. Here in a fragrant garden, amidst the splash of many fountains and the songs of tropical birds, they discuss with the jeweler the designing of the new necklace. The jeweler has no show-cases; he does not advertise. He sits cross-legged on the floor, with his tools scattered about and a small hot blaze of fire with which he evolves his works of art.

The mass of materials is spread out; all take a hand in suggesting. Excitement runs high; dozens of changes are made; and the artisan untangles each artistic dilemma, bringing beautiful order out of chaos. And so the design is born, the only one of its kind. The beturbaned, barefoot smith carries away the materials selected and in ten days returns with a creation which is the despair of the Occidental, because it outrages every one of his canons and yet bowls him over with envy and admiration.



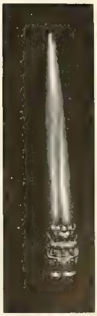
(Above) MEASURED in terms of this half-pound nose ring, the belles of the vast Tibetan plateau must be equal to any sacrifice in the name of beauty. It is a choice gem of the jeweler's art, composed entirely of gold and precious stones. Measuring six and one-half inches in length, it hung far below the chin, and the owner, while eating or drinking, was obliged to hold it up out of the way, thus exposing the reverse side, equally gorgeous. Emeralds, rubies, turquoises, diamonds, rock crystals, topazes, moonstones, and amethysts, set in yellow gold, give it a radiant color scheme



(Right) AN ORNAMENTAL Tibetan prayer box of pure silver. Here we have an object regarded with the deepest reverence among those devout people who live all their lives at 16,000 feet above sea level. It is suspended by a beautiful chain of coral, silver, and turquoise beads. The front of the box bears a picture of Vishnu surrounded by a rainbow, painted on rice paper. Inside the box are many prayers on parchment, rice paper, and satin. Age speaks from every part of the piece. It was acquired in Pekin, where some pilgrim had probably parted with it under dire necessity, fully intending to redeem it but never able to

THE DELICATE LADY who wore the necklace at left was mild and gentle of mien; the chief part of her education had been devoted to dancing. The necklace is of gold, chain and all, and is set with 69 gems. Its design carries one immediately to Siam—to enchanting temples in the jungle and little brown girls wearing their odd tapering crowns

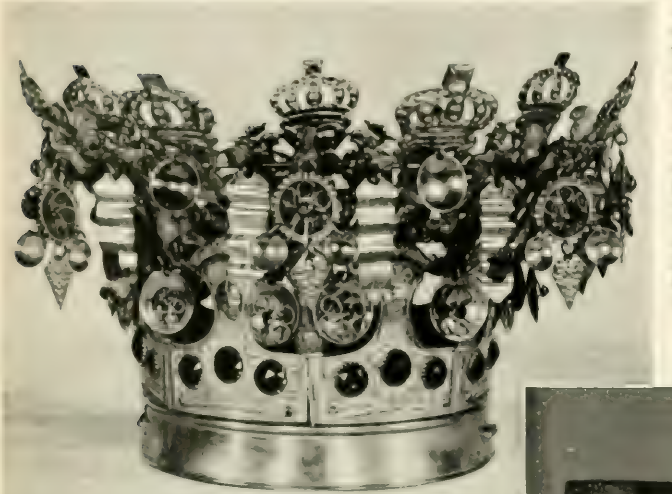
IN CHINA the upper court ladies allowed their fingernails to grow to fantastic lengths to prove that they never demeaned themselves by performing the most trifling labor. To protect them they wore silver guards from two to three inches long, like these at left and right. This is perhaps the most outlandish form that vanity has ever assumed on this earth. Men, too, have followed this weird custom — aristocrats, officials, and scholars. But the custom has waned, or disappeared, since the Revolution of 1912



As the road to the Hardanger Fjord there is a [illegible] that climbs from the water's edge up and up. From the [illegible] heights, where everlasting snows [illegible] in the summer sunlight, torrents flow down. With tumultuous and thunderous expostulations, the waters battle savagely with the rocks. And [illegible] through the [illegible], [illegible] and wreaths of drifting spray, climbs the road, [illegible] and [illegible] the stream. Tucked away along its course, on shelves and benches of the mountainside, [illegible] villages. Merok is among them. There is an unforgettable view of the [illegible] where bees and birds add their music to that of the water.

Here and there, pretty maidens with golden curls appear. Amid such surroundings what else could they be but charming,—charming of person, charming of spirit. If you doubt it, look at their glorious adornment, a beautiful bride's crown we found there. Something of the music of that mountainside, something of the long starry boreal nights, appears in this headdress for a comely Viking maiden. A mind that grew in these surroundings was needed to create it, and only faces and forms native to this Norwegian landscape could grace it.

Imagine the original massive gold, silver, and bejeweled masterpieces of royal adornment which were the sources of this beautiful object. A mental picture is conjured up of stately queens in towered castles, of glittering halls, and regal gatherings. There arises also another picture of a quaint shop and an ingenious artist-smith, busy creating the forerunner of this glorious piece. The shop is small, the



A NORWEGIAN BRIDE'S CROWN. With a violet ribbon passing under the milk-white chin, and the golden locks swaying to the dancing feet, the violet-blue-eyed Viking maiden who wore it must have made a lovely picture. Seven crowns form the circle, held aloft by fourteen lions. The pendant bunches of grapes are symbolic of fertility. The gems are garnets and emeralds. Between each two crowns stands a silver Pan blowing his pipes, and there are seven faces of brides with flowing locks. The crown is but one piece of a spectacular bridal ensemble, which descends through the generations

(Left) PEASANT DAUGHTERS wore modest adornment, but the emblematic bunch of grapes was never absent. In this bride's necklace, the central coin of gold bears the head of Franciscus and is dated 1754. One of the smaller coins is marked 1727, but the other two are too worn to be read

(Right) GOOD LUCK TO THE NORWEGIAN BRIDE. A married couple adorn the pendant disk, the woman seated on the man's knee, with a child and an eagle on either side. Two cupids hold a floral wreath above the central couple, and castle turrets rise in the background. Attached to this disk are three emblems, all protective

man simple—it happened centuries ago.

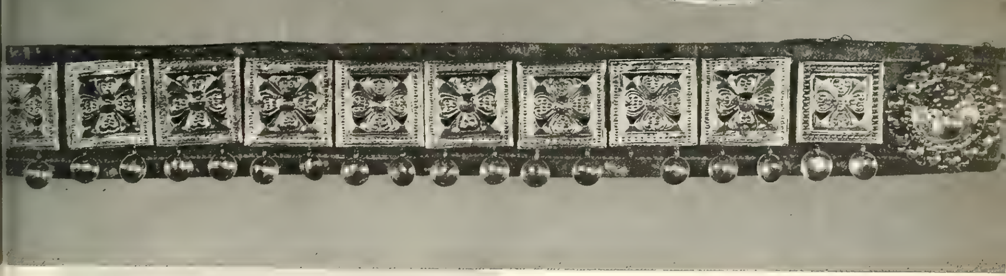
IT has been gratifying to see this ancient "loot" of ours, gathered from the four corners of the world, reborn as motifs for present-day modes. Professional designers have found their inspiration in many authentic old pieces in our collection, but most exciting has it been to see student designers in our own school use the material in the creation of new patterns, a number of which have been developed and sold from coast to coast.

A new understanding of what is true and real in artistic design is necessary to the future of American art. Failure on the part of professional artists to make full use of museums and other collections, as much as poor taste on the part of the buying public, has made possible a world market for atrocities. In our travels we have seen an ever-increasing quantity of garish gimcracks being sold. Opulent and apparently educated tourists purchase curios in Egypt or Turkey marked as having been made in factories in Birmingham, Czechoslovakia, or Japan.

In the new era approaching, the Machine Age, America has a great task to perform in preserving cultures that have taken thousands of years to build. The debased and spurious must ever be recognized and rejected, and a fresh culture built up. Commercialism and exploitation of the merely trite in art must be combatted wherever they show their ugly heads. Only in this way can new artistic ideals of beauty arise, like the fabled phoenix which appears on so much of our older art, from their modern ashes.

(Right) THIS ESTHONIAN bride's breastplate, nine and one-half inches across, was worn in the center of the breast, attached by a pin. Etched with crosses, birds, and floral designs, it is extremely rich in appearance and weighs one pound

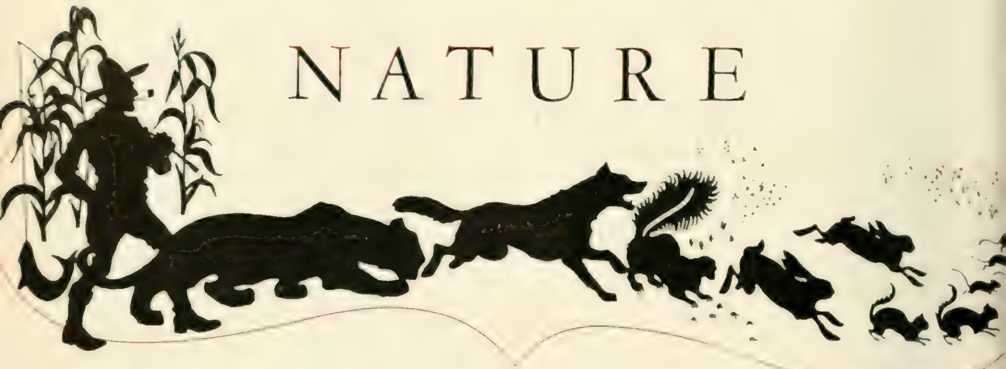
(Below) THE WELL-TO-DO BRIDE wore a silver belt, gold-plated, composed of fourteen pieces, each adorned with little concave disks that sparkle with every slightest movement. The vermilion-red cloth, edged with brocaded green ribbon, adds color



THE ICELANDERS were a hardy race, whose lives are expressed in the austere simplicity of their ornaments. This bride's crown from the author's collection, wrought in gold probably from Norway, reveals all their dignity and simplicity. It is similar to that worn in Ireland 700 years ago, or before the conquest by Strongbow. In Iceland it reflects the dim, shadowy past, back toward the time of Leif Ericson

BALANCED

NATURE



THE MOUNTAIN LION, coyote, and other predatory animals serve as a cushion between man and a host of potentially destructive creatures

By SHERMAN BAKER

[illegible]

Why Pick o

THE man with the big hat stops his Ford pickup cautiously, and reaches over.

"Gimme the gun," he mutters to his wife in the seat beside him.

It is getting dark, and the colors are draining out of the Arizona sky. In the fading shadow of a big mesquite beside the road, a grayish form about the size of a small German shepherd dog slinks away.

There comes a sharp crack, then another. The sound seems small and unreal in the immensity and vastness of the landscape.

"It's a damn ky-oat. I got him," the rancher says sharply, with pride in his voice.

The car grinds gears and swings away toward the darkening mountains. Beside the road a coyote thrashes in the dry dust, twitches feebly, then lies still.

This is a familiar scene in any Western state. It is a rare Westerner who won't go out of his way to kill a predatory animal. And many are the wandering cowpunchers who have practiced their roping on the dodging coyote, and have dragged a coyote to death among the cactus and the rocks. Our true Western rancher hates the coyote with an intense and personal sort of hatred. And with an intensity varying with the frequency he meets them, the rancher despises the hawk, wildcat, cougar, eagle, and others.

Because of the present war the conservation-minded Fish and Wildlife Service of the Government is being subjected to increasing pressure for complete extermination of the predators. The campaign of wildlife slaughter by strychnine carried on by the old Biological Survey in the name of "National Defense" during the last war is still fresh in many memories. The American Society of Mammalogists called the Biological Survey "the most destructive organized agency that has ever menaced so many species of our native fauna."

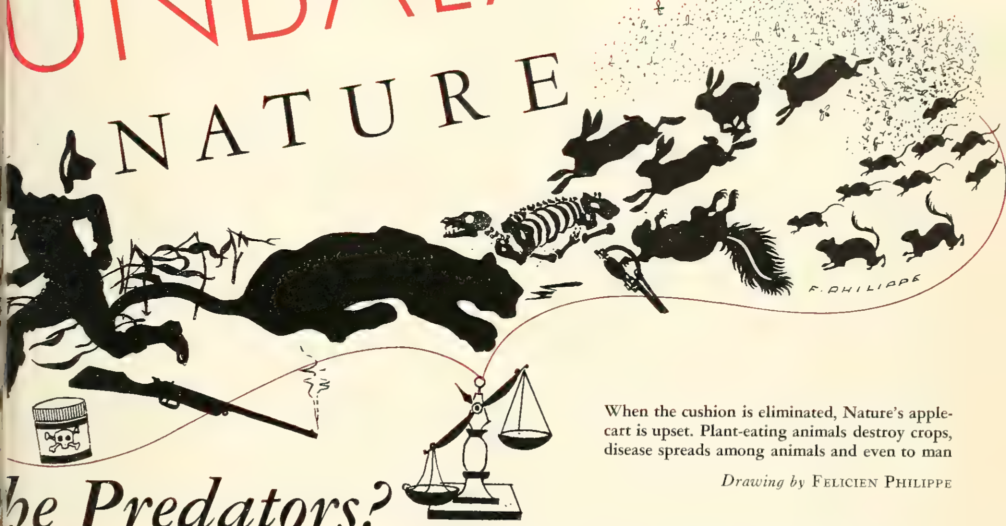
"But why not?" the rancher or the hunter may ask. "The predatory animals do plenty harm. They do a lot of damage to livestock. They, especially the coyote, are a menace because of rabies."

Hunters haven't much good to say of them. "Predators kill off our game animals. I, for one, can't compete against a mountain lion when I go deer hunting!"

Both the hunter and the rancher are right, to a certain extent. They both act according to what they think are their best interests. But actually, is the extermination of the predators to their best interests, and to the best interests of a Nation in Arms? Some of us think not,—some of us who are both ranchers and hunters.

In New Mexico a friend of mine runs sheep. One dark night a "killer" coyote got into the flock and left a trail of blood. One sheep after another this coyote

UNBALANCED NATURE



When the cushion is eliminated, Nature's apple-cart is upset. Plant-eating animals destroy crops, disease spreads among animals and even to man

Drawing by FELICIEN PHILIPPE

he Predators?

had slaughtered, apparently just for the sake of tasting blood. My friend the sheepman is vociferous in his demands for the complete extermination of the coyote. This sheepman has a real grievance, and in sheep country the coyote and other predators must be controlled. But even the sheepman admits that not every coyote acts this way. Only certain individual coyotes who get the "killer" habit run amuck in this manner. Government authorities estimate the total loss of sheep from all causes to be from five to twelve per cent of the flock. The main causes of loss are poisonous plants, diseases, and parasites. In spite of the occasional "killer" coyote, loss to Western sheepmen from *all* predatory animals is only from one to three per cent of the flock. The use of trained shepherd dogs will keep to a minimum sheep losses from predators.

In cattle country the story is different. Many progressive cattlemen admit that the coyote is relatively harmless to their livestock, and that as the least of several evils the coyote is to be preferred to, for instance, the harmful rodents which he holds in check.

I have seen some cases of living calves with their ears or tails chewed off presumably by coyotes, but there are not many more serious complaints by modern cowmen against this predator. In my particular locality—a remote, mountainous section of Arizona—I have yet to find a cattleman who has any definite, objective complaint against the coyote, although all the local cowmen follow the tradition and kill the coyote on sight. Most of the wild stories about cattle losses from coyotes emanate from "old-timers" whose tales grow with each telling. At the old McKenzie Ranch in New Mexico during one spring about 1000 cattle out of the herd of 6000 head had been found dead and chewed by coyotes. This situation occurs frequently, and this typical fact has been the foundation of all sorts of wild reports about the danger of coyotes to cattle. A further investigation of the death of these 1000 cows showed that they had all died of starvation during a bad drought year. And the coyotes had chewed the dead carcasses!

The coyote or bobcat steals an occasional chicken or turkey from isolated settlers. The chicken squawks loudly, very loudly indeed. And that squawk echoes and re-echoes throughout the community until we might think that Hitler's parachute troops had finally landed and had captured the county courthouse. Of course, it is impossible to obtain any actual figures on poultry losses to predators, but I sincerely believe the actual number to be comparatively small. However, it is quite thrilling to hop out of bed on a cold night, grab for the old .30-30 and run outside to the chicken house, with your dog barking excitedly at your heels, the children calling from the windows. It is the old surging thrill of the chase, right down from paleo-

[illegible] years. And [illegible] [illegible] [illegible] kept [illegible] [illegible] [illegible] makes interesting [illegible] around the kitchen stove of an evening. One of my neighbors, [illegible] drew him [illegible] a wilderness [illegible], for [illegible] [illegible] complains bitterly of the frequent [illegible] depredations on his chickens. When actually pinned down, however, he confessed, "Wal, reckon I lost a couple of hens to a [illegible] back in 1924, and [illegible] one or two to skunks or bobcats since then. And one three years ago to a hawk."

Coyotes and other animals do contract that dread disease, rabies, or hydrophobia. But authorities tell us that the coyote does not act as a "reservoir" of the disease, but gets it from the dog. It is much easier to control rabies in the dog than it is in wildlife, however. Dogs can be inoculated against the disease or, during an epidemic, they can be muzzled. You can't do that to coyotes and skunks,—and, in spite of popular superstition, rabies is *not* endemic among skunks.

"Well, how about our game animals?" the hunter may repeat. "Everybody knows that the predators kill game. Everybody knows that a mountain lion, for example, kills an average of one deer per week, or 52 deer each year. If that isn't killing off our game animals, I'd like to know what it is!"

Again the average hunter, who feels this way, is right, to a certain extent. Carnivorous animals live largely on herbivorous animals. Nobody questions that. Predators kill game animals, and the hunter's figures on the yearly kill of a cougar are probably correct.

But the question is much more complicated than that. Wildlife is not just a simple matter of so many cougars and so many deer, for instance. There exist in nature many complex and subtle relationships that we do not even suspect. It is not possible, for example, to produce more game merely by killing off the predators. In some areas the opposite has been true. Sometimes the exterminated species has acted as a check on some unforeseen condition, and a new and unsuspected problem arises to baffle the wildlife expert.

In the years 1907-1919 a single Government hunter killed over 600 lions on the Kaibab National Forest on the north rim of the Grand Canyon. The Forest Service and the Biological Survey had decided to exterminate the mountain lion, to "save" the deer for the hunter. What happened in the Kaibab is well known to all wildlife lovers. It may best be summarized in the following quotation condensed from a report of the National Park Service, an organization with a progressive and intelligent interest in conservation:

> The cougar, the bobcat, wolf and eagle were all completely exterminated by 1919. The deer increased and reached such numbers that they ate more forage than the forest could produce. By 1924 more than seventeen hundred deer were counted in one meadow. The deer kept increasing and the forest diminishing. Winter came, the deer died of weakness and starvation, and those that lived ate every leaf and twig they could reach, until the whole country looked as though a swarm of locusts had swept through. It will probably take fifty years of careful game management to cover the scars. If there had been more moderate hunting of both deer and predators, the situation in the Kaibab would not have occurred.

And, to make the situation more complex, clumsy and wholesale methods of extermination aimed at one particular species, such as the coyote, often fail in their purpose and exterminate valuable and useful species.

When a mountain lion kills a deer, he kills the deer that he can get most easily. The sickly and unfit deer fall first, and in that way the cougar acts to keep the deer stock healthy and at its best. With game animals, as with everything else, continued existence is a matter of the survival of the fitter. Diseased and unfit animals and birds fall first to the mammal or bird of prey. The hawk gets the diseased quail first. The mountain lion gets the unfit deer first. The coyote gets the sick cottontail first. By keeping the game stocks at their best, the predator really aids, rather than hurts, the hunter.

Hawks and eagles are shot on sight, indiscriminately, throughout the West. Ornithologists have recently been puzzled by the rapid increase of epidemic illnesses among our game birds. As far as we know, nothing of the sort happened to the quail, dove, and turkey our pioneers roasted over early campfires. Perhaps the reason is that our wrongly-educated hunters have shot the predatory birds on sight, and thereby unwittingly destroyed one of nature's best checks on epidemics among game birds.

"Yeh," the hunter or the rancher may again say. "What you say may be true. The ky-oat and the rest of the predators may not really do so much *harm*. But I certainly can't see that they do much *good!*"

The villain in the play hasn't even one good side to his character. The villain in real life usually has some redeeming qualities. When a bobcat gets our chicken, it is hard to realize that predatory animals have anything but bad qualities, but, like the real-life villain, our real-life predators *do* have good sides to their characters. Let us try for a moment to look at these good sides.

In the first place, the predators have one good side to their natures that will appeal especially to the hunter. This good side is that important matter we have just discussed—keeping the game animals healthy and fit so that John P. Nimrod can bring home a fat buck to his admiring wife and children. A second beneficial quality of the carnivores, especially the much-maligned coyote, is their action as scavengers. By the prompt elimination of rotting carcasses of both wild and domestic animals, the predator becomes a sort of practical public health officer in the general animal economy. By preventing the persistence of carcasses on the domestic watersheds, he effectively reduces the hazard of microörganisms pathogenic to man.

In most states hunters are permitted to shoot only the bucks. In consequence, the does have increased, are tamer, and cause a lot of damage to crops and orchards. The predators, if allowed in normal numbers, help to keep down these harmful does, taking the unfit first, of course.

A fourth point in the predators' favor is that many predatory animals are valuable fur-bearers. Authorities state that in California alone—and California isn't a particularly good fur state—private trappers make at least one million dollars annually. Wanton destruction of the predators at any time of the year destroys a valuable fur crop.

A fifth entry on the credit side of the predators' ledger is that there exists some sort of dynamic relationship between the predators and the edible flora in any given area. In other words, the number of carnivores in a locality is a mathematical function of the number of herbivores and the available feed. Nature has thus preserved a subtle and delicate balance. Man should think twice before he meddles with this dynamic balance. The Kaibab situation is an example.

A sixth and final point that I want to bring out in favor of the predaceous animals is that they perform useful service to mankind by acting as a check on harmful rodents. We all know that the coyote keeps down the range-eating jack rabbit. What many of us don't realize is that the coyote, and other predators, keep down the possibility of man's frequent contamination with two very serious diseases—tularemia and bubonic plague. In California, two outbreaks of those horrible illnesses have been traced directly to the local extermination of the coyote and the subsequent increase of the rabbit and the ground squirrel.

The Old West was full of animal gangsters. The lobo wolf and the terrifying grizzly bear committed mayhem, murder, rapine and robbery up and down the mountain trails of the early West. Some idea of the multitude of grizzlies that roamed the plains a hundred years ago may be gained from the notes left us by the trappers of the first half of the last century. James O. Pattie saw 220 grizzlies in the course of one day. When the white settlers began to come in, the wolves and the bears killed cattle and horses, and even men and women. The grizzly was more guilty of the latter, for the American wolf was never as ferocious as the European wolf. But the grizzly and the wolf have almost completely disappeared from the United States and no longer constitute a personal or economic problem to American ranchers.

The rest of the American predators are afraid of man. The jaguar (*Felis onca hernandesii*), *el tigre* of the Mexicans, is extremely rare north of the border. The mountain lion (puma, cougar, catamount, panther, or "painter" according to locality) is comparatively well scattered in some of the more sparsely-settled districts of the West. In my range of mountains—an area of over 100 square miles of uninhabited wilderness—cattle graze peacefully beneath the evergreen oaks. I see frequent lion tracks along the cattle trails. But in the five years I have lived here, I know of no instance of a mountain lion having killed the ranchers' livestock. The mountain lion is one of the most cautious, secretive and wary animals we know of. It is a notoriously cowardly animal, with no record of ever having attacked a man even when wounded or treed by dogs. They are so cowardly that they can be treed by a noisily-yapping little fox terrior.

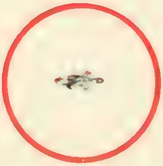
Intelligent people are more and more beginning to consider the predaceous animals as "occasionally harmful, but usually beneficial." If poultry and sheep are properly protected, wildcats and coyotes devote their attention to rabbits, other small mammals, insects, wild berries, and so on. The fox destroys large numbers of harmful field mice, rabbits, ground squirrels and insects. The mink and the skunk commit depredations on poultry, but more than pay for it by destroying muskrats, meadow mice, grubs, noxious insects of all sorts. And the badger feeds largely upon ground squirrels and other burrowing mammals and insects.

"So what?" asks the rancher or the hunter, or the public in general.

"Just this—" we may reply. "Maybe you think the predators are all bad. You have as much right to your opinion as I have. But the next time you lift the muzzle of your shotgun toward a hawk, or point the sights of your rifle at a coyote, just remember that the predator may be evil, but that he is at least not a complete evil. Remember that in some hunter's or rancher's Utopia, when the predators are completely exterminated, and when some sickness sweeps away the quail, or the deer, and when the rabbits are eating away all the grass for the nation's beef and mutton supply, remember that the predators would have prevented that epidemic from wiping out the game, and the rabbit from multiplying so prodigiously. A sound program of conservation for National Defense means *control*, but not extermination, of the predatory animals. Remember, just as you are about to squeeze the trigger, that the predator isn't really such an enemy to man, after all."

THE QUEST FOR

Most fishermen strive to catch the biggest fish, but one of the most fascinating searches has been for the world's smallest fish, a creature so tiny that no hook is delicate enough to catch it and 16,000 of them make a comfortable—and delicious—meal



WORLD'S SMALLEST FISH:
the "dwarf pygmy" *(Pandaka pygmaea)* in actual size

YOU CAN BUY 16,000 delicious fish for only a few cents at Lake Buhi in the Philippines, but their total weight would be no more than a pound! The palm of the hand at right is scarcely covered by 100 or more fish caught in this lake, and they are apparently not even the smallest kind

THE SMALLEST FISH

By E. W. GUDGER

Honorary Associate in Ichthyology, The American Museum of Natural History

ONE of the questions most frequently asked of of us here in the Museum's Department of Fishes is, "What is the largest fish?" For 22 years I have been answering that it is the whale shark, that ocean Brobdingnag, which has been measured up to 45 feet. At some future time I am going to bring together all the data for it and other marine giants in the endeavor to ascertain what *is* the largest fish and to settle the question.

Another frequent question is, "What is the smallest fish?" Various brief attempts have been made to give the answer, but no effort has ever been made to present the full picture of the search that brings together all the interesting points in the natural history of these little fishes. To present these findings is the purpose of this article, but to achieve this end, one must reverse the usual procedure in fish stories.

The usual story is as follows: *A* tells about a big fish that he caught; *B* narrates the story of his catching a bigger one; whereupon *C* relates the story of the biggest one—the one that got away. Now this article (fish tale, if you will) recounts the finding of an adult fish so small that its discoverer proclaims it the smallest. Then another searcher finds one still smaller, so does another, and still another, until a tiny fish is found, a fish so Lilliputian in size that all hands agree that the lowest limit must have been reached.

In January, 1902, Dr. H. M. Smith published a note on a minute Philippine goby, which aroused such widespread interest in the question that Einar Lönnberg published an article on small fishes in the same year. Later A. W. Henn (1912) and Jessie Elliott Drayton (1933) took up the search. However, these articles are all so indefinite, incomplete, and unsatisfactory, that they may be passed by without further comment. Thus the way is clear and possibly the time ripe for an endeavor to find what *is* the smallest fish.

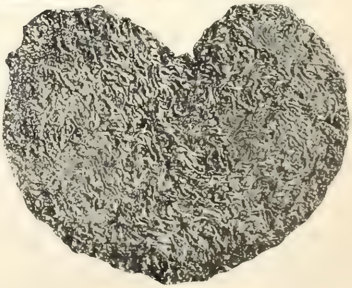
In seeking to ascertain what is the smallest fish, it seems well to go downward from small to smaller to smallest. This seems logical and it will make the story chronological. Starting near the middle of the last century and working up to date, it will be in-

Photos by Hugo Miller

(Above) HOME OF THE SMALLEST FISH: picturesque Lake Buhi. This small but beautiful body of water on the island of Luzon in the Philippines possesses more kinds of minute fishes than any other section of the world

The strangest fish cakes on earth. Thousands of the world's smallest commercially valuable fish form these *sinarapan* fish balls, esteemed as a delicacy by natives and whites in the Philippines

After H. M. Smith, 1902



[illegible] the various steps by which [illegible] of fancy have pushed our knowledge forward to smaller and smaller forms. Following this devious path the reader and I will at last reach a "dwarf pygmy" that must be the irreducible minimum in smallness for adult fishes and indeed of all backboned animals.

One requirement in this search is to have a considerable number of specimens to determine the range of size in any one of our small fishes. Above all, we need females in breeding condition to determine the size of adult females. In the males, with no gravid females present, it is not possible, save by microscopic examination of the gonads, to determine whether the fishes are adult.

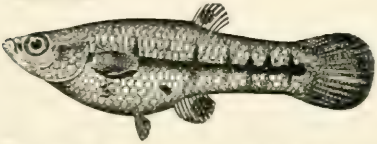
Smallest North American fishes

The search for the smallest fish was first prosecuted among North American forms. This is due to the fact that in the fresh waters of the United States there are certain cyprinodont (carp-toothed) fishes called "top minnows," notable for their small size and for the fact that many of them are viviparous, or "live-bearers." (This means that they give birth to young able at once to swim, seek their food, carry on their own lives.) Among these little fishes are certain ones long thought to be the smallest of all fishes.

So far as I can find, the man who first announced that he had found the smallest fish was C. F. Girard. In 1859 (82 years ago) he wrote, "The smallest fish so far known to inhabit fresh waters is *Heterandria formosa*. . . . When full grown the female measures about an inch in total length, and the male six-eighths of an inch."[1] These little fish came from South Carolina and Florida along with other somewhat larger related forms, all having teeth like carp, and all closely akin to them. That the reader may see how this fish looks, there is reproduced here a drawing of the fish enlarged about three times, and along with it are others showing the fish in natural size. These latter are from Samuel Garman's book, *The Cyprinodonts* (1895). Garman does not speak of the size of these drawings, but, as those of the females measure 25 and 29.5 mm. respectively and that of the male 19 mm., it is clear that the figures are drawn in natural size. And they are so reproduced here that the reader may have visual evidence of the extreme smallness of this little "top minnow."

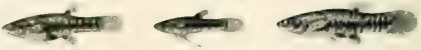
It will be of interest and value here to give another bit of the interesting natural history of these small cyprinodonts. These little viviparous fishes are called "top minnows" because, in order to feed at the surface, they swim with back and mouth at the top of the water. In their natural environment, they feed largely on mosquito larvae at the surface of the water, and hence help keep down mosquitoes. Their extremely small size fosters their larvivorous activities. Mosquito larvae hide in the growths of water plants along the edges of lakes and ponds. Our little fishes readily penetrate among the plants and feed on these larvae. One of these active little fishes will in a short time devour his own weight of mosquito larvae.

Now it is well known that certain mosquitoes are the transmitters of the germs of malarial and yellow fevers. The International Health Board of the Rockefeller Foundation, in its fight to eliminate malaria and yellow fever, has enlisted the services of many small fishes in various parts of the world, among which it has found these top minnows to be its most valuable "mosquito fleet" auxiliaries. It has widely distributed these and other similar ones around the globe to the great benefit of the people in regions subject to these diseases. The fishes are



(Left) **THE AMERICAN "TOP MINNOW"** which in 1859 was thought to be the smallest fish in the world: *Heterandria formosa*, enlarged three times

The female is mightier than the male. At right: two females and a male between them, all life-size. **These Lilliputian fish feed on mosquito larvae** and have served nobly as a "mosquito fleet" against malaria and yellow fever



After Garman, 1895

"planted" in ponds, tanks and cisterns to keep them from becoming breeding waters for the mosquitoes which transmit the diseases noted.

Twenty-six years after Girard's account, O. P. Hay described in 1885 a cyprinodont from Florida waters so small that he stated it might contend with the fish we have just described for the honor of being the smallest known vertebrate.[2] He had two specimens from Florida. The largest was seven-eighths of an inch from tip of snout to tip of tail. The smaller (for which unfortunately no measurements are given) on dissection was found to be "a female with well-developed ova." Hay's little top minnow (to which he gave the name *Heterandria ommata)* is a first cousin of Girard's *Heterandria formosa.* Hay gives no illustrations of this fish, nor do I know of any.

Both these fishes and their close kin are so small that their measurements are better given in metric units, which enable us to record minute differences more exactly. In this system an inch equals 25 millimeters. Thus Girard's specimens were 25 and 19 mm. long respectively. Hay's larger fish (a male) was 22 mm. long. It is unfortunate that he did not give the length of the other and smaller specimen —"a female with well-developed ova."

South American rivals for smallness

C. H. Eigenmann in 1909, in describing some fresh-water fishes of British Guiana, listed a number of other very small cyprinodont fishes.[3] Among these was the little viviparous *Acanthocephalus bifurcus.* "Some of the females but 20 mm. long are with young." The smallest male (in breeding colors) measured 19 mm.—three-quarters of an inch. Here then is a live-bearing fish 20 mm. long with the ovaries filled with numbers of babies ready to be set free to seek their own living. Eigenmann published no illustration of his fish.

Still back in the past (1895), Samuel Garman, in his great work on the carp-toothed fishes, established the form *Heterandria minor* from specimens from Villa Bella, Brazil. Of the fishes of this species, he says, "The length of the males is about seven-tenths of an inch [17.5 mm.] and of the females about eight [20 mm.]. Females of three-fourths of an inch [19 mm.] in total length contained fully developed embryos." And thinking that he had found the smallest Heterandria and indeed the smallest cyprinodont, he named this little fish "minor" (i.e., smaller than any other). It was at that time the smallest known fish. Garman gives no illustration of this "minor" fish, nor have I been able to find one.

Leaving behind these little American top minnows, our search for the smallest fish in the world now takes us to the Old World, but to what was in the year concerned an American possession—the Philippine Islands. The story involves two stages in research as will be seen presently. The fishes to be studied are gobies.

The gobies (order Gobioidea) comprise a large group of some 600 species of coastal, estuarine, and fresh-water fishes from all over the world save inside the Arctic and Antarctic circles. The gobies are mainly carnivorous, mostly small in size, and they abound in the Philippine Islands. A. W. Herre, in his book, *Gobies of the Philippines and the China Sea* (1927), has listed no fewer than 173 species in the surrounding waters. The gobies are small fishes, ranging generally from 100 mm. (four inches) down to less than 25 mm. (one inch). Perhaps the greater number of forms range in size below two inches. Various species do not attain a size larger than about 20 mm. in length.

It would be interesting to list all of Herre's little Philippine gobies smaller than 20 mm., but I shall note only those smaller than Garman's "minor" cyprinodont, the males of which measured 18 mm. and the gravid females 19 mm. The gobies now to be studied are so small that they would seem to have reached the *ne plus ultra* in diminutiveness.

"The smallest known vertebrate"—1902

In 1901, a small collection of fishes came from the Philippine Islands to the U. S. Fish Commission, in Washington, D. C. All were collected in Lake Buhi in southern Luzon. This is a small but beautiful lake about six miles long by three wide and having an average depth of about 160 feet. Its surface is about 325 feet above sea level. It is said to have been formed by a volcanic explosion and eruption prior to the Spanish Occupation ". . . when one side of Mount Iriga was blown out, and hills of lava were scattered for miles to the southeast of the mountains."

These fishes from Lake Buhi were carefully studied by Dr. H. M. Smith, referred to above. Among them was a species of goby which Doctor Smith announced to the world in *Science* on January 3, 1902, as "The Smallest Known Vertebrate." Later in the year in a fuller and more formal paper (*Bulletin U. S. Fish Commission,* XXI, 167) he included illustrations of both the male and the female fish, and described this little goby in more detail, giving its natural history so far as then known. He named it *Mistichthys luzonensis* ("smallest fish from Luzon"). This is surely a long name for such a short fish. Nor is its [illegible] and it was the smallest adult fish that had ever been described.

Doctor Smith [illegible] specimens of both sexes. [illegible] and general [illegible] of the fish are shown in the drawings of [illegible] and female specimens at the foot of this page, where the fish are shown magnified six times. The inset below each figure represents the actual length of the fish in the flesh (13 mm.). The fish are almost unbelievably small. "The average length of 50 specimens taken at random, both sexes about equally represented, is 12.0 mm. [one-half inch]. The average length of males is 12.5 mm., the minimum under 10 mm., and the maximum 13.5 mm. The average length of females among specimens at hand is 13.5 mm., the minimum under 12 mm." These figures show how inadequate inch measurements are, and how necessary it is to use the metric system in giving [illegible]. But it must be emphasized that these are *adult* fish.

The females contained ripe eggs. Indeed, when some females were placed in alcohol, perfect eggs were extruded. These eggs averaged 0.5 mm. in diameter and were probably the smallest fish eggs on record in 1902. Their extrusion by the female shows that this fish, unlike the cyprinodonts studied, is egg-laying, not live-bearing. It should also be noted that the maximum size of this little goby is far less than the minimum size of Garman's little cyprinodont called "minor" (13.5 mm., against 19 mm.).

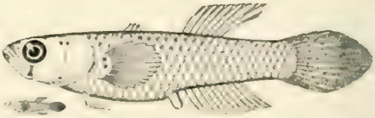
Smith's studies were made on preserved material, but Herre (who then lived in the Philippines) visited Lake Buhi, collected many specimens, and so far as possible studied the natural history of Mistichthys. In fresh specimens, he found these "minute fish" to be transparent, with large black eyes and some few dark spots sparingly scattered over the body and in some parts making faint stripes or bars. The fish are found in vast numbers, mainly around the shores. They seem to breed throughout the year.

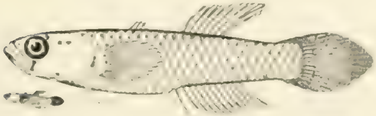
Commercially valuable

Incredible as it may seem, these little fish are used as food. They are the smallest fish having a commercial value. In fact they are food fish of considerable importance and are in great demand. Of them and their capture—they are of course too small to be taken even in a reasonably fine-meshed net or trap—Doctor Smith's correspondent, Dr. Zeller, assistant surgeon, U. S. A., wrote as follows:

> I enclose herewith samples of a strange article of diet [illegible] in the Bicol [illegible], where I have been stationed for the past eighteen months. Rice and fish are the staple articles of diet for most Filipinos and in the [illegible] of the Camarines there is little variation from these two. Fishes of every size and many varieties are presented in every conceivable form, but the samples enclosed are unique in that they are found here and nowhere else. . . . Many varieties of fish abound in the lake, but by far the most numerous are these minute specimens. They are called in the native Bicol tongue [illegible], and when dried in the sun [illegible] are called [illegible]. They are caught in a large sheet of [illegible] which is dipped under a school of [illegible]. They are put into tightly woven baskets, from which the water soon drains, leaving a compact mass of fish. They are not minnows or immature fish. They are adults and attain no greater size. The natives buy them eagerly; and when the little fleet of fishermen return from their morning's quest and place their baskets upon the ground in the market place, they are instantly surrounded by a crowd of waiting children who, armed with every sort of dish, are anxious to take home the family meal. They bring three or four potato tubers, a handful or two of rice, or a few copper pennies and in exchange receive about a pint of fish. In the kitchen the fish are made up with peppers or other spiced herbs and they do not taste bad. The soldiers have become quite fond of this food, and liberally patronize the little native restaurants where it is served.

A SHORT FISH with a long name: *Mistichthys luzonensis*, which means "the smallest fish from Luzon." At right is the female; below is the male, with insets showing actual size





In 1902 it was the smallest fish that had been discovered, but a smaller fish was destined to be found, and in the same island in the Philippines

For illustrations of the cakes of *sinarapan,* as for those of the fish, I am indebted to Doctor Smith. These cakes are made up of vast numbers of the minute fish. "The number in one pound is about 16,000."

Herre writes that another little goby, *Mirogobius lacustris,* of which mature adults vary from 15 to 19 mm., also has a commercial value. These little fish, unlike *sinarapan,* are not made into dried cakes but ". . . are fried in cakes, cooked in vinegar, made into *sinagong* or stew, and pickled, and are a greatly esteemed delicacy. At times they occur in the Manila market."

In reference to the commercial value of Mistichthys and its use as food, Herre adds that, "*Sinarapan* are fried in oil, or boiled with vegetables, and have a delicious flavor. When more are caught than the local market demands, the surplus is salted or dried in cakes and exported to the neighboring towns in Camarines Sur or Albay Provinces."

It is interesting to find that the use of these minute fishes for food around Lake Buhi had been recorded nearly half a century earlier. Dr. F. Jagor had collected and sent to Germany in 1860 numbers of very small gobies from Lake Buhi, with the statement that under the native name of *roron* these were daily consumed in great quantities. They were probably *sinarapan.*

Since these little fish are of such commercial value, certain rules and regulations governing the fishing are based on their habits. Of these Herre says:

> I believe that *sinarapan* [which live at the bottom] rise to the surface with the diurnal movement of the plankton on which they feed. The unusual method used to capture them is based on this habit and provides a roosting place on which they gather in swarms. From time immemorial they have been caught in large quantities by the people living about the lake and are regarded by them as a staple article of diet of superior delicacy. The right to catch them is let by the municipality to the highest bidder, who then has the exclusive fishing privilege for such part of the lake as he has leased.

Doctor Zeller has described one method of taking *sinarapan,* and Doctor Herre, from personal observation, has described another and more interesting one. His account of this will add to our knowledge of the natural history of Mistichthys. He writes:

> A full-grown bamboo stalk, ten meters or more in length, is cut, the butt sharpened, the branches removed except the three or four uppermost twigs, and a palm leaf wrapped around the topmost meter or two. The contrivance, called *abung,* is then set firmly into the lake bottom where the water is deep enough to leave a little of the tip and a spur of the palm leaf protruding above the surface so the fisherman can find it easily. During the day the *sinarapan* come to rest upon the palm leaf. About the middle of the afternoon the fisherman goes out to the *abung* which he has scattered about in his leasehold, and begins to fish with a triangular net or *sarap.* . . . The *sarap* is mounted on a **Y**-frame of bamboo and with it the *abung* is swept from the bottom of the palm leaf to the top, and usually from a half liter to a liter of *sinarapan* is caught on each. The fish are dumped into a large basket from which the water drains at once, leaving what appears to be a mass of some strange wriggling, skipping, transparent insect larvae, in which the large black eyes are the only conspicuous part.

These tasty little gobies are the prey of many larger fishes. At times, eels, halfbeaks, and several kinds of larger gobies (their cannibal cousins) are taken with them in the nets. Thus, Herre records a goby *(Vaimosa dispar),* ranging from 18 to 40 mm. in length and states that "many of them had the mouth greatly distended with *sinarapan* when captured, the tails of as many as three or four protruding."

Doctor Smith's article in *Science* aroused great interest, as is witnessed by its translation and republication in French, German, and Swedish. Then Doctor Smith himself wrote a short article for *St. Nicholas* Magazine (June, 1902), which is valuable just here, because in this he had a sketch of the *Sinarapan* drawn on a smaller scale than the ones already reproduced; and—most fortunately—underneath the head of the fish in the larger drawing is an illustration of the "least fish" in *natural size,* one-half inch long. This charming combination is reproduced that the reader may get a visual impression of just how little this "least fish" really is.

But small as is the little fish (13 mm.) shown in Doctor Smith's small illustration, a smaller fish is now to be presented.

Despite Smith's announcement in 1902 of the finding of Mistichthys with an average length of only 12.9 mm., the smallest fish had not been found and was not to be discovered and recorded for another quarter of a century. This was done by Herre in 1927. He had two new species of small gobies which he placed in a new genus called Pandaka, from a Philippine word appropriately meaning dwarf. However, the first of the Pandakas, which he designated as *pusilla,* meaning little, was not a new record for smallness.

Smallest fish on earth

In the discovery of *Pandaka pygmaea,* we have at last come to our journey's end. But without seeing specimens, it is hard for one to realize that a female fish only 10 mm. long (two-fifths of an inch) can be adult and capable of reproducing its kind. Years ago, Doctor Herre sent me some specimens, and they are before me as I write. They are so minutely small that seen under a strong magnifying glass [illegible] could see no details. [illegible] Because of this, Herre named the [illegible] Pandaka pygmaea—the pygmy dwarf or the dwarf pygmy. [illegible] as Paul, "After the most straightest sect of our religion, I lived a Pharisee."

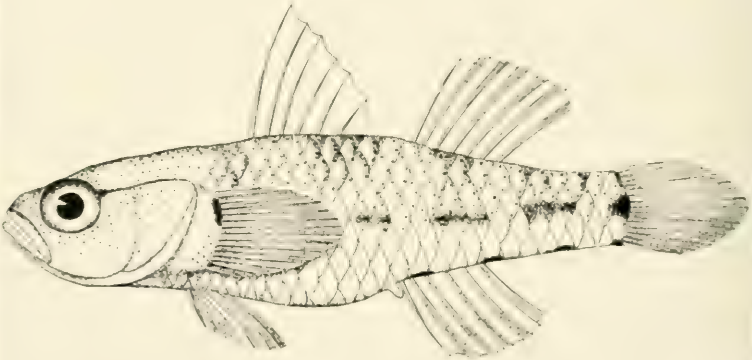
We [illegible] so unbelievably small, it will be well to quote Herre's exact words:

> [illegible] 8 to 11 millimeters [illegible] (Mistichthys luzonensis) of Lake Buhi. I have examined all the gobies thus far known from Polynesia and North America, and none is as tiny as this species.

Here let us pause to consider the drawings showing [illegible] small size of this pygmy. The drawing below shows our Pandaka enlarged [illegible]. Even more interesting is the small figure on the title page of this article showing the pygmy in its real "grown-up" size.

Herre's natural history data concerning the dwarf pygmy goby are buried in his book. Consequently, [illegible] The Smallest Living Vertebrate. From this it will be interesting to quote his final paragraph describing this ichthyological atom.

> [illegible] *Mistichthys luzonensis* and *Pandaka pygmaea* are very much smaller, even when not so very much shorter. They are both slender fishes and in life are colorless and so nearly transparent that only their large black eyes are visible. Conditions in the Philippines and especially in Luzon have produced an extraordinary variety of gobies, but it is remarkable that the island of Luzon should have produced the two smallest specimens of fish in the world, both gobies.



The smallest fish in the world enlarged to fifteen times its actual size: *Pandaka pygmaea*, whose life-size portrait is shown on the first page of this article. The "dwarf pygmy" is a trimly built mite, colorless and nearly transparent

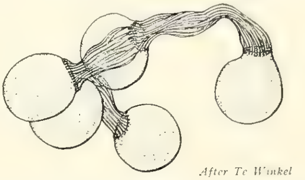
One wonders what are the conditions in Philippine waters and especially in the one island, Luzon, that have given rise to these Lilliputian forms—not only Mistichthys and Pandaka, but many others less than 25 mm. long when sexually mature. However, on this matter even Herre, who knows more about these atomic gobies than anyone in the world, does not proffer a conjecture.

Cell size

One other matter calls for brief consideration in studying these miniature fishes. One does not need to look twice at an illustration of one of these small gobies to know that all its organs and tissues are of miniature size and proportions. Then comes the reasonable question, "Are the cells they are made of likewise smaller than those of larger fishes?" Fortunately this problem has been studied by Dr. Lois Te Winkel in a thoroughgoing article on Mistichthys published in 1935.[4] She formulates the matter thus: "A most important point is whether the extreme dwarfism of Mistichthys [Pandaka and the other minute gobies noted above] is due to a reduction in the size of cells [composing the body]." This subject, she has studied in the literature and by microscopic work on sections of the bodies of Mistichthys, other gobies, and of bony fishes in general. The subject is technical but can be discussed briefly in general terms.

Most students of microscopic anatomy agree that gland cells and those of other organs that are constantly being torn down and rebuilt vary little in adult size and are not correlated with body magnitude. But permanent cells, like those of nerve and muscle, which early attain their normal proportions, do vary somewhat in size with body size, due to individual growth of the cells. Thus, "Except for brain and muscle cells, the size of cells in the mouse and the elephant is approximately the same. . . . Large animals differ from small animals chiefly in cell numbers and not in cell size." In her minute goby, Doctor Te Winkel found that certain highly specialized cells are somewhat smaller than those measured in other bony fishes. She states that the reduced size of these cells, is in all likelihood correlated with the minute adult size of Mistichthys. But the general conclusion may be drawn that the unusually small size of these tiny gobies is not accompanied by any unusually small size of the cells making up the tissues of the body. Some other cause or causes must be found for this dwarfish condition.

However, before leaving this subject, there is one cell of Mistichthys that is so small in comparison with all others of its kind in fishes that it deserves special consideration. The egg (a single cell) is, like the fish, minutely small. Smith in his imperfectly preserved specimens noted the eggs as being 0.5 mm. in diameter. In far better preserved material, Doctor Te Winkel found 20 to 40 round or oval eggs in the ovary of a female. These eggs measured 0.37 to 0.4 mm. in diameter—*less than the size of the period at the end of this sentence.* These are the smallest fish eggs on record, but their describer notes that "they are *relatively* very large—the largest diameter being one-twenty-fifth the body length of the female fish."



After Te Winkel

INFINITESIMAL "CAVIAR": five eggs of Mistichthys, the "least fish"—in 1902. Here enlarged 35 times, they are actually the size of the period at the end of this line.

Doctor Te Winkel's figure of five of the eggs *enlarged 35 times* is reproduced here. They are tied together by their intertwined filaments. Gobies are bottom dwellers, and these adhesive filaments serve to fasten the eggs to shells and stones. But the eggs of Mistichthys rise to the surface and are found in patches entangled with one another, with algae, and other small objects. There they hatch, and the young then go to the bottom.

Why all these very small fishes attain and maintain in adult life such minute sizes is at the present time an unsolved problem. Fortunate will be he who can find the key to the mystery.

Furthermore, the question will not down. "After a search of 68 years, going ever from a little fish proclaimed the smallest to one still smaller, down to an adult 10 mm. long,—have we found at last *the* smallest fish?" Who knows? The future only can answer.

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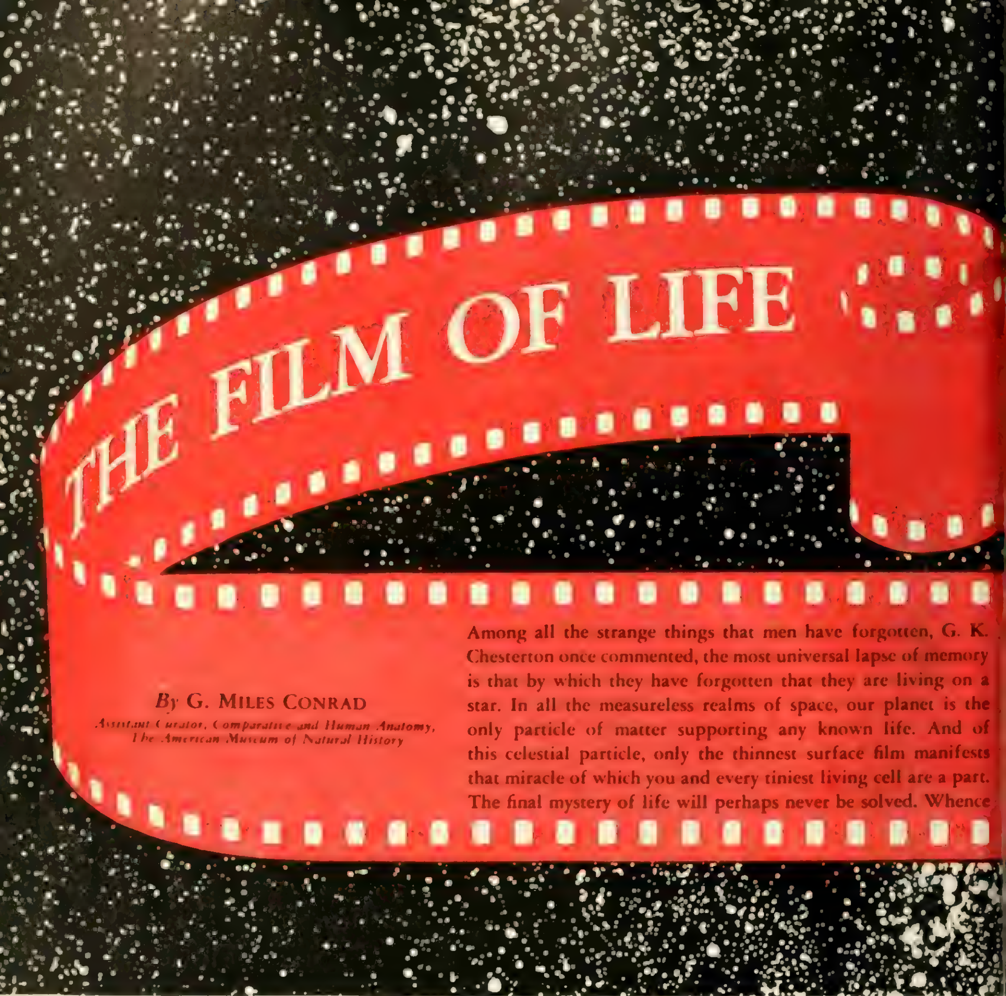
[1] C. F. Girard, in *Proceedings of the Academy of Natural Sciences of Philadelphia*, II (1859), 62.

[2] O. P. Hay, in *Proceedings of the U. S. National Museum*, VIII (1885), 555.

[3] C. H. Eigenmann, in *Annals of the Carnegie Museum*, VI (1909), 52.

[4] Lois Te Winkel, "A Study of Mistichthys, with Special reference to . . . Reduced Size," *Journal of Morphology*, LVIII (1935), 463-534.

When specifically concerned with smallness, the published reports of the authors mentioned in this article are listed under SIZE in Bashford Dean's ***A Bibliography of Fishes*** (1923), III, 498.



THE FILM OF LIFE

By G. MILES CONRAD

Assistant Curator, Comparative and Human Anatomy,
The American Museum of Natural History

Among all the strange things that men have forgotten, G. K. Chesterton once commented, the most universal lapse of memory is that by which they have forgotten that they are living on a star. In all the measureless realms of space, our planet is the only particle of matter supporting any known life. And of this celestial particle, only the thinnest surface film manifests that miracle of which you and every tiniest living cell are a part. The final mystery of life will perhaps never be solved. Whence

Scattered through the infinity of space are countless spiral nebulae—star systems so vast as to dwarf our solar system to insignificance. From out in space we would have to train our most powerful telescope on a very small part of the right one of these star systems to

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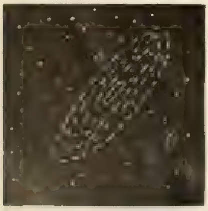
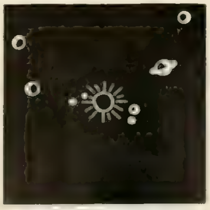


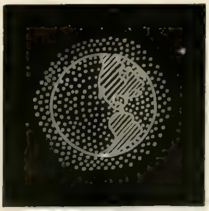
see our sun, with its nine planets, of which the earth is one. Singling out the earth, we move closer and see that a hazy atmosphere clings to the surface of the globe, through which we recognize—

2



the continents. Solid land makes up $\frac{1}{3}$ of the surface, water $\frac{2}{3}$. Crawling over and clinging to the sides of this whirling planet is life. The faint green of plants covers large areas; movement of animals is almost everywhere.

3



If we were to cut the earth in tw
in our cosmic laboratory, v
would find that the liquid su
face is but the thinnest coatir
and that the solid portion is th
true core. A few feet unde
ground all life ceases.

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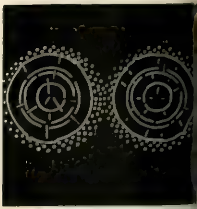
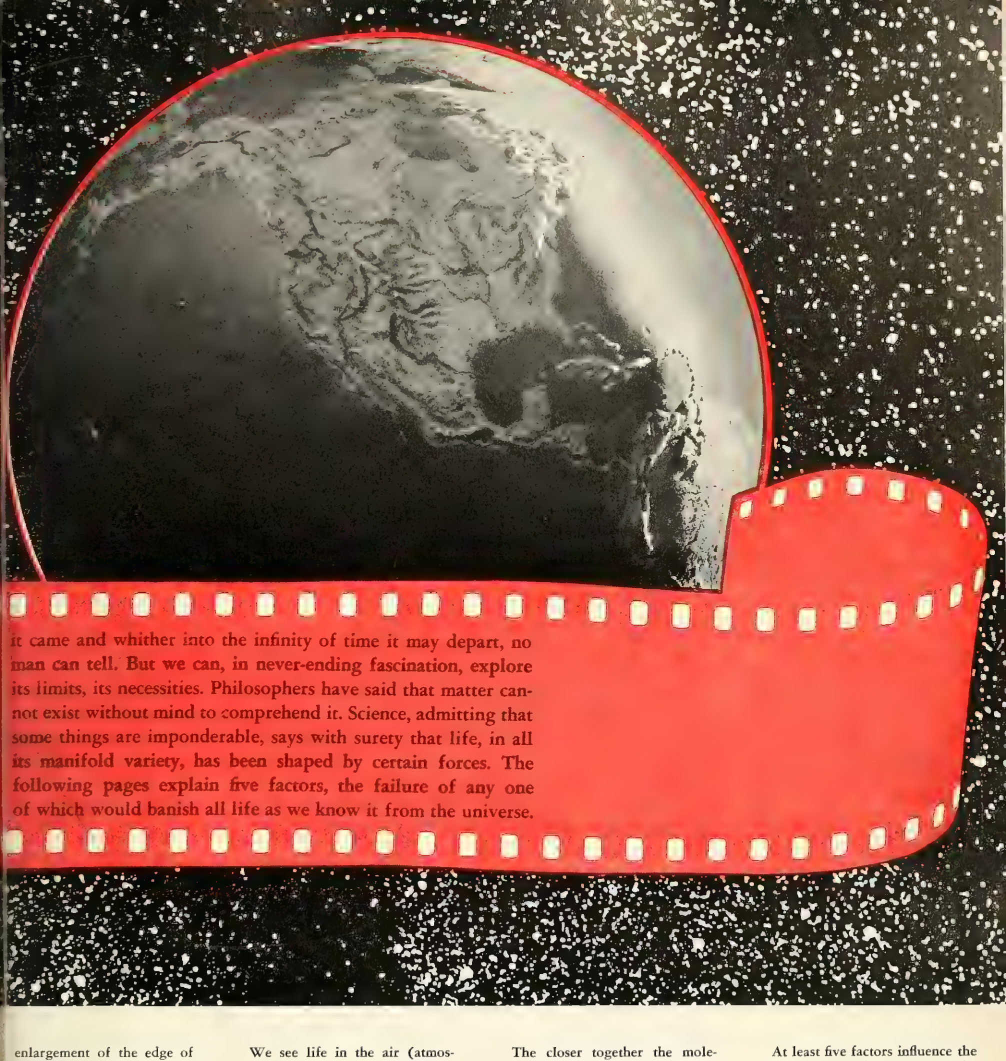
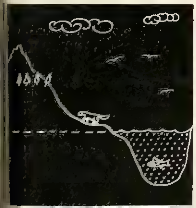




it came and whither into the infinity of time it may depart, no man can tell. But we can, in never-ending fascination, explore its limits, its necessities. Philosophers have said that matter cannot exist without mind to comprehend it. Science, admitting that some things are imponderable, says with surety that life, in all its manifold variety, has been shaped by certain forces. The following pages explain five factors, the failure of any one of which would banish all life as we know it from the universe.

enlargement of the edge of r earth section where air, land, l water meet, shows that life confined to a thin "film" about miles in depth. This is the ly realm containing any known in the vast immensity of ce.



We see life in the air (atmosphere), in the water (hydrosphere), and on the land (lithosphere). The molecules making up air (A) are relatively far apart; those of water (B) closer; and those of the lithosphere (C) quite solidly packed.

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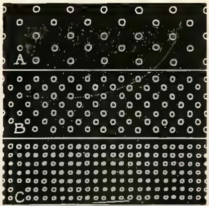

The closer together the molecules are, the greater the supporting power, but also the greater resistance to an object moving through the medium. It is harder for a bird to keep from falling than a fish, but it can travel faster.

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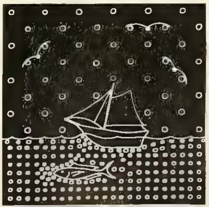
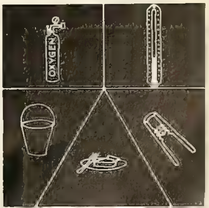


At least five factors influence the presence of life whether in the air, in water, or on land. These different but usually interacting factors are (1) oxygen, (2) temperature, (3) moisture, (4) food, and (5) pressure.

8 ↓



Oxygen is a [illegible] and [illegible] gas [illegible] found almost everywhere on earth. [illegible]

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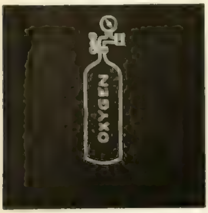

Many life processes are oxidations, in which oxygen combines with other substances in the body to produce energy and heat. A candle flames brightly in a steady supply of oxygen but flickers and dies when the oxygen is exhausted.

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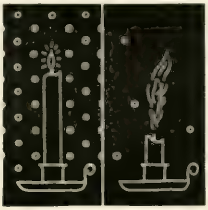

Just as the fuel in an engine is ignited in the presence of oxygen to produce energy, so does the combustion of food in the body produce muscular power. Without oxygen protoplasm—the basic substance of life—disintegrates.

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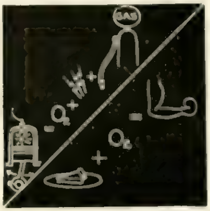

At sea level the normal content of the air is 20 per cent oxygen (○) and 79 per cent nitrogen (●), plus small traces of other gases, such as argon, krypton, neon, and so forth. This is more oxygen than is generally needed by animal organisms.

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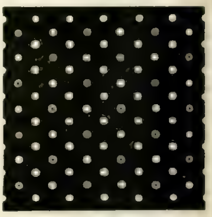

Most of the oxygen dissolved in water is derived from the air. It is captured in two ways: by diffusion at the surface and by agitation. Diffusion is a continuous process but too slow to meet the needs of water creatures.

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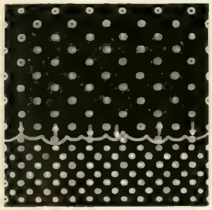

But agitation by waves and waterfalls is most effective in supplying oxygen to the waters. Air is captured and pulled under the surface by curling waves. The amount of oxygen water can hold depends on temperature and salt content.

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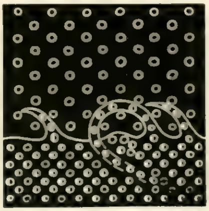
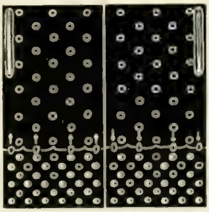


Warm water cannot absorb as much oxygen as cool. That is why polar waters support an abundance of marine life, which few people realize. Conversely, water containing a lot of salt cannot hold as much oxygen as fresher water.

19



The warmth of tropical waters causes them to have relatively little oxygen in the top 1800 feet. But polar waters have three levels: *surface* layer, with much; *middle* layer, with little; and *bottom*, with a fair amount. The great depths have none.

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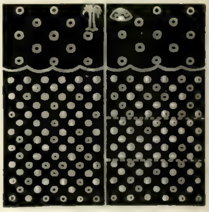

The original source of all warmth on the earth is the sun, even that of the earth's molten core. This is easily checked when we remember that nights are so often cooler than days, a sunny day warmer than a cloudy one.

25

Each hemisphere receives the same amount of heat in a year. But where the rays strike vertically they penetrate less atmosphere and are hotter. So, the heat varies with latitude and, since the earth's axis is tilted, with the seasons.

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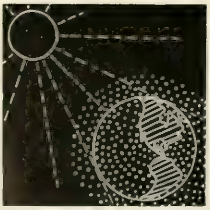

Land and water absorb the heat from the sun more readily than air. Indeed, much of the heat from the sun passes through the air to the earth without loss and warms the air only after it has warmed the land and the water.

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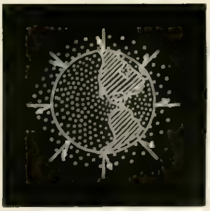
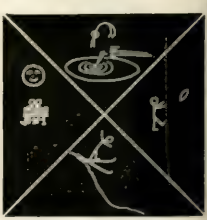
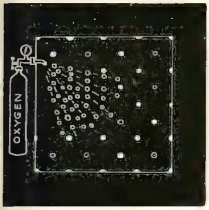


When land and water grow warmer than air, they radiate their heat,—causing convection currents to rise, unequal pressures to develop, and winds to blow. These things, coupled with the earth's annual orbit, make our seasons.

28



But under the stress of extreme muscular activity, oxidations will apparently proceed more efficiently with 3 or 3½ times the oxygen normally needed. Excessively higher amounts are deadly but are never found in the natural environment.



At high altitudes and in great ocean depths, oxygen is deficient. At 18,000 feet there is about half the oxygen there is at sea level, so the heart and lungs must do twice as much work to provide the body with the same amount of oxygen.

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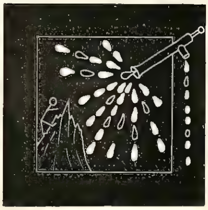

Amounts of oxygen in water vary greatly, and many water animals have developed accessory breathing organs. A number of fishes rise to gulp air. This is dissolved in water, which in passing over the gills yields its oxygen to the blood.

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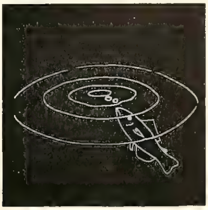

The atmosphere is the main source of free oxygen. The heavier gases, oxygen and nitrogen, hover close to the earth and do not occur much over 35 miles above sea level, the absolute upper limit at which life could exist.

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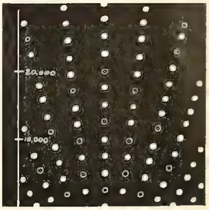
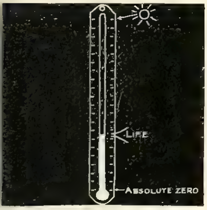
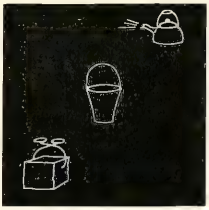


From the heat of the sun's surface to absolute zero are 11,291° F.; and of this, life is limited to a range of 150°, or about 1%. Protoplasm, the basic stuff of life, freezes at 23° F. and coagulates at 158° F.



Under different conditions of heat and pressure, all matter may exist as a solid, a liquid, or a gas. If it is not to solidify or boil away, life must remain within the narrow range of temperatures which limit the thin film of life.

22 ↓



Animals can be divided into two groups: warm- and cold-blooded. The warm-blooded maintain a constant body heat regardless of the weather. This is efficient, because the internal chemical processes can then continue at a constant rate.

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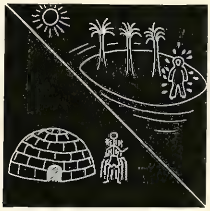

On the other hand, the body heat of the cold-blooded animal varies with the temperature of its surroundings. Thus, extreme of cold or heat will upset the internal chemical balance, and performance will be inefficient and erratic.

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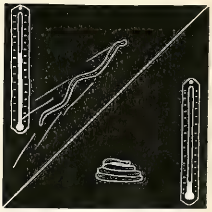
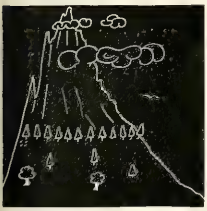
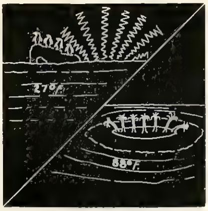


The higher we go, the colder it grows, until we reach space where the temperature is —459° F. Snow line ranges from near sea level in the Arctic to 16,000 feet in the tropics; 3000 feet above this it is apt to be too cold for unprotected protoplasm.



The air does not readily absorb heat and is disturbed by cold and hot winds, hence temperature varies greatly over the earth, from —130° F. to +149° F. But in the oceans, the range is only from 27° F. to 88° F.—*ideal for protoplasm!*

30 ↓



Water is never found in a chemically pure state in nature. It is the "universal solvent" in which are dissolved the foods and wastes of living organisms. There is every reason to believe that life originated in the water.

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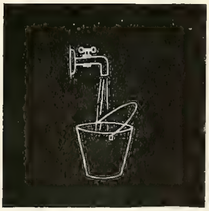

Most of the animals that subsequently evolved moved into an atmospheric environment, but none have ever been able to break completely away from the primordial water environment, even after hundreds of millions of years of evolution.

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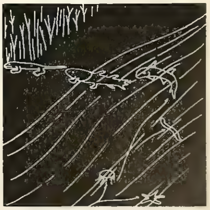

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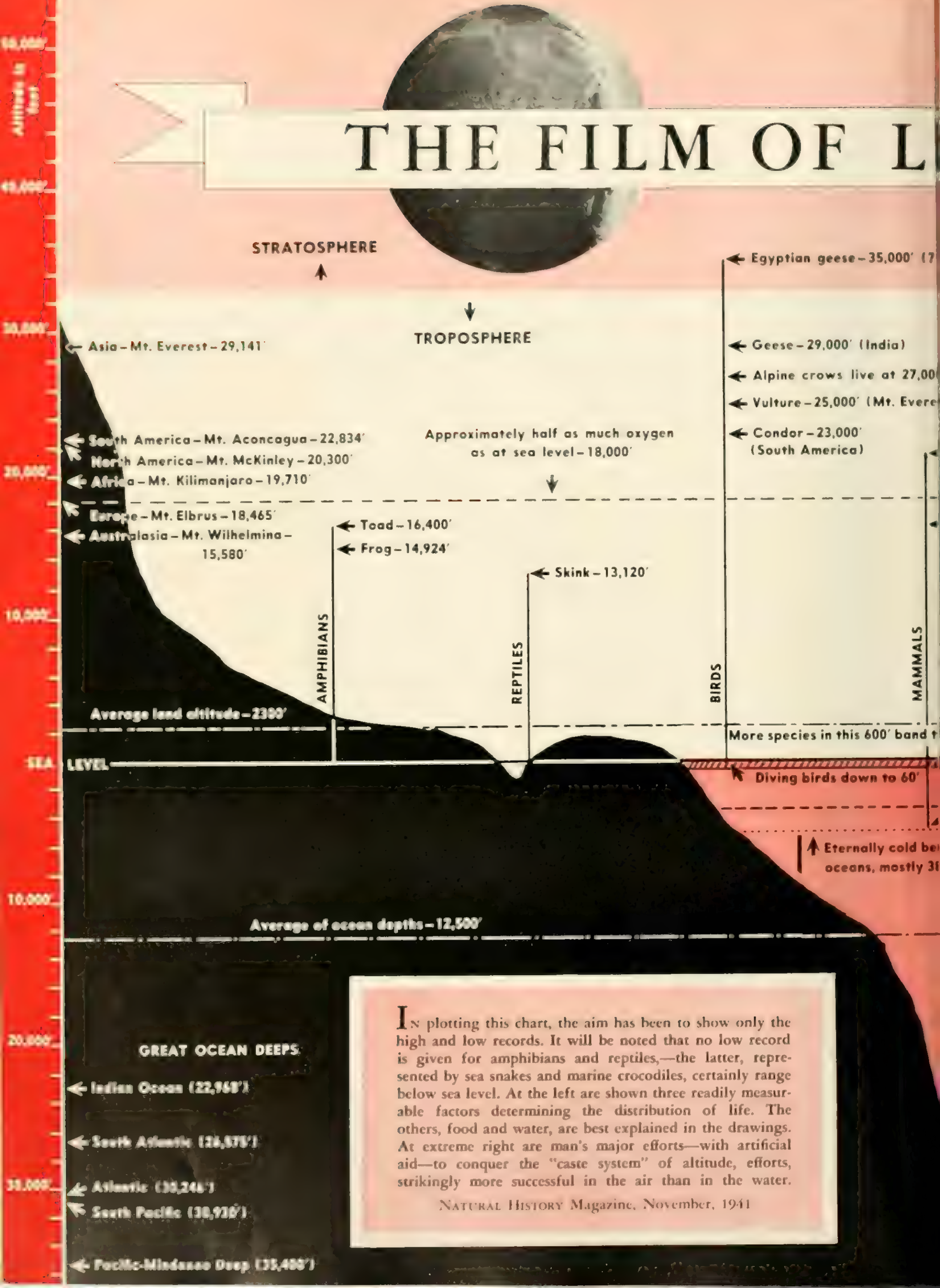

In plotting this chart, the aim has been to show only the high and low records. It will be noted that no low record is given for amphibians and reptiles,—the latter, represented by sea snakes and marine crocodiles, certainly range below sea level. At the left are shown three readily measurable factors determining the distribution of life. The others, food and water, are best explained in the drawings. At extreme right are man's major efforts—with artificial aid—to conquer the "caste system" of altitude, efforts, strikingly more successful in the air than in the water.

Natural History Magazine, November, 1941

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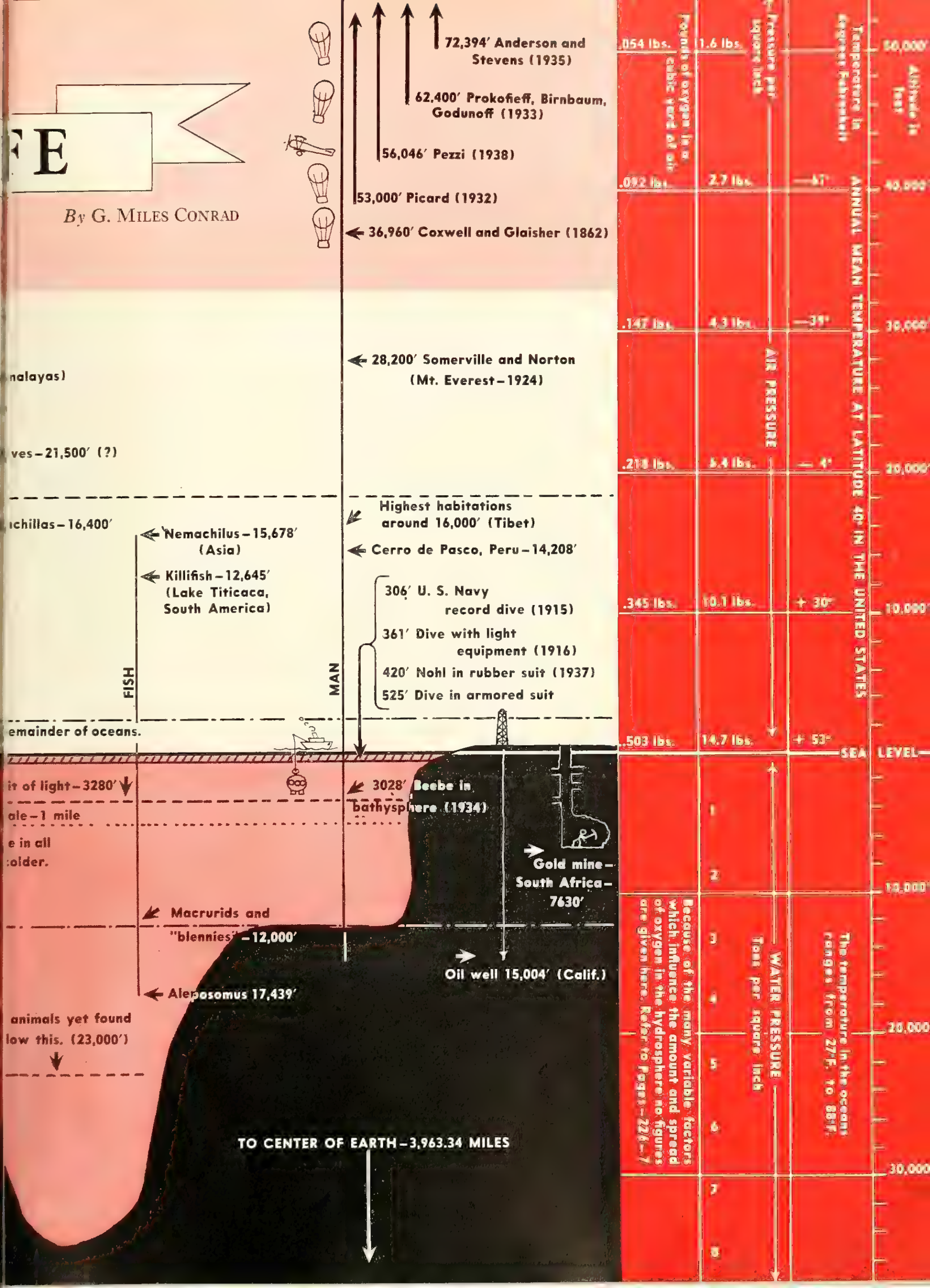
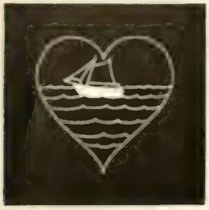
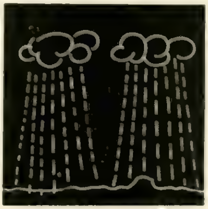
By G. MILES CONRAD



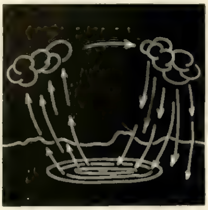
33 Indeed, so tied to the primitive environment are the land animals that they carry fluids in their tissues which contain a percentage of salt similar to that of the seas. To maintain this internal salt solution, water must be available.



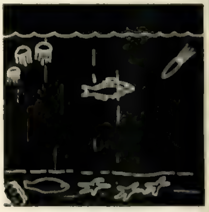
34 Water vapor is found up to an altitude of twelve miles, above which no animal could possibly exist. This vapor, derived originally from the hydrosphere, is condensed and precipitated in the form of rain and snow.



35 The sprinkling system of the atmosphere is a perpetual motion process whereby water taken from the reservoir of the hydrosphere (oceans, lakes, and rivers) is redistributed over both the lithosphere and hydrosphere, aiding life greatly.

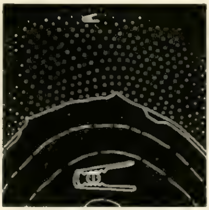


36 To dwellers in the hydrosphere, water is obviously no problem. Although water is customarily divided into "salt" and "fresh," the distinction is merely a quantitative one, for most fresh waters contain a liberal solution of salt.

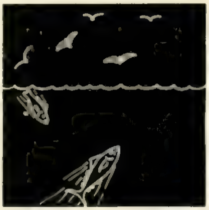


37 Pressure is squeezing or compression—it is the power of our fingers to crack the nut. Life is under constant conditioning by just such squeezing. Normally the internal pressure of an animal equals the environmental pressure.

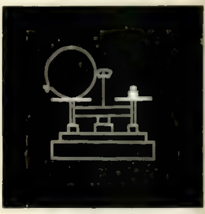
38 But whether the animal lives in air, water, or on land, when it moves toward the earth's center the pressure increases. And if it moves in either direction too rapidly, trouble follows, for the pressure balance is disturbed.



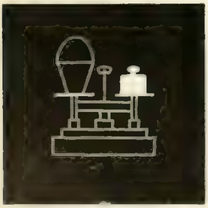
39 If the animal descends too rapidly, external pressure will try to crush delicate organs. If he ascends too rapidly, the body tends to burst. But only animals that travel up or down quickly need special pressure adjustment mechanisms.



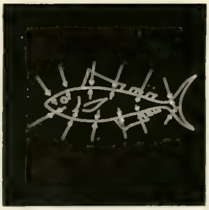
40 The pressures acting upon life are of two sources—air and water. It is hard to realize that air has any weight, but at sea level the 150-mile-high column of air over our heads weighs 14.7 pounds, or "one atmosphere."



41 The higher we go, the lower the pressure becomes, until the vacuum of space is reached. However, a column of water only 34 feet high exerts a pressure of one atmosphere, and a short distance underwater one suffers from the pressure.

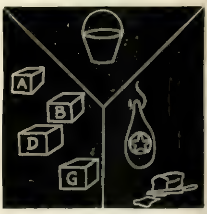


42 In the great oceanic depths, pressures are so great that they are measured in tons. But it must be emphasized that as long as the internal body pressure is the same as the pressure of the environment, the organism suffers no harm.

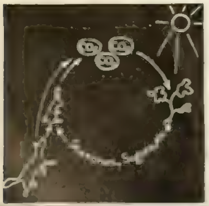


43 Food must provide, (1) the energy for running the living machine and the material for the generation of body heat, (2) the materials necessary for the renewal of worn-out protoplasm, and (3) materials for growth.

44 The stuff used by animals for food is (1) inorganic (water and salts), (2) vitamins, and (3) organic materials (proteins, carbohydrates, fats, and oils). In a sense, food is sun-energy stored by plants and taken by animals secondarily.

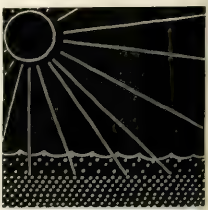


45 Animals that eat other animals are eating food that has all been manufactured from plants. To flesh-eaters, the rabbit is a food factory, transforming unpalatable greenery into meat and exhaling carbon dioxide that the plants can use.



46 Plant-eaters are limited in their range vertically by the limits of plant life; but flesh-eaters frequently exceed the plant ranges. The ocean is less favorable to plant growth than the land, because sunlight penetrates only shallowly.

Thus ends our "news reel" of *The Film of Life*, with its five actors—Oxygen, Temperature, Water, Pressure, and Food—limiting the vertical range of animals to a thin film in the vast immensity of space.



GEM FOR NOVEMBER

The golden brown of the topaz is supremely fitting for this autumn month, though many stones that pass as this distinctive gem are but clever pretenders

By Frederick H. Pough

Acting Curator, Geology and Mineralogy, The American Museum of Natural History

THE least known and least appreciated of all common gems is that selected for November. Even among the ancients there was considerable confusion in the use of the name ***topazos*** (from the Greek, meaning "to seek"); and mineralogists are extremely uncertain as to exactly which stone was meant. By many it is thought to have been the peridot. Pliny tells of an "Island of Topazos" that was almost perpetually shrouded in fog. But once mariners reached the spot, they were able to obtain the stones in reasonable abundance from the natives, who alone, according to the legend, could detect their presence. Probably other stones also traveled in the topaz omnibus, but we cannot distinguish them today. Chrysolite of the Bible may well have been our topaz.

Mineralogists have never confused, in modern times, the mineral topaz with any other substance. Topaz is a complex compound of aluminum, fluorine, and silica. Like tourmaline, quartz, and corundum, it is a distinct mineral, and like them, it comes in many colors—red, blue, yellow, or green. There is a universal misconception that topaz is brown, and by circuitous reasoning that a brown gem is always topaz. Modern mineralogists have never been guilty of confusing the topaz with anything else—but, oh! the jewelers! The jewelers have been mixed up ever since brown quartz was found in Spain and marketed under the name of "Spanish" topaz." "Cape rubies" and "evening emeralds" have deceived no one in the trade; no books have been written in which garnets were confused with rubies, or emeralds with peridots, or diamonds with rock crystal. But volumes have been written in which topaz was confused with almost everything brown.

After "Spanish topaz" had been marketed for a number of years, the discovery was made that amethyst which had been heated attained a similar shade. To the jeweler this opened up wonderful possibilities, for the supply of faulty amethyst suitable for "burning" is very large. Today the stores are filled with "topaz" which should more properly be sold as citrine quartz. The value and source of amethyst and most citrine quartz are the same, the latter merely having passed a brief interlude in an electric furnace. There is also a natural citrine very similar in appearance to the heated amethyst, and it, too, is sold as topaz.

Topaz is one of the most attractive of all gems, a stone with a lively fire. A fine golden brown topaz is indeed a beautiful jewel. Few stores carry it, and those that do, sell it under the name "precious topaz" to distinguish it from the far less precious citrine quartz. The finest stones come from Brazil, the only locality now known for gems of this type, though similar stones once were found in Russia. But brown is not the only color of our true topaz: another common hue is pale blue, looking for all the world like a light aquamarine but having far brighter internal reflections. These, too, come from Brazil, but since they are so little known in this country, most are sold locally. A colorless topaz is sometimes cut and sold, often as white sapphire.

The story of the changing of amethyst and other gem colors by heat is an interesting one. Topaz itself is susceptible to heat treatment. When rich brown Brazilian stones are placed in sand and slowly heated they become, on cooling, a fine violet pink. The coloring is permanent, and treated stones are known as "pinked" topaz. They were formerly more in use than now. Many old pieces of jewelry are set with pinked topaz,—often with a colored foil backing that intensifies the color. To avoid such trickery for improving the hue or brilliance, all stones should be set so that the buyer can see the back of the stone.

The Morgenthau Topaz. From Japan this stone traveled to America, where it was cut in 1915 by Anthony J. Espositer. Its 444 facets represent about 100 hours of tedious and exacting work

AMNH photos

The world's largest topaz. Found in Brazil, this unique mass of fluosilicate of aluminum weighs 596 pounds. Examining the crystal are Mr. Whitlock, Curator Emeritus of the Department of Geology and Mineralogy, Mr. Faunce, Vice-director of the Museum, and the author

The mystic powers of topaz are perhaps a little indefinite because of the confusion accompanying the name. Topaz is mentioned in the Bible as forming one of the gates of the Holy City. Having the ruby's power in reverse, it was supposed to quench the heat of boiling water. Insomnia and asthma were cured by the powder taken in wine. Topaz was said to confer cheerfulness upon the wearer, to calm the passions, and prevent bad dreams. A gem held in the hand by a woman at childbirth was said to lessen the suffering.

Yellow sapphire is often called "Oriental topaz," and this has not decreased the confusion. Yellow sapphire is usually more golden than true topaz, but otherwise resembles it closely and has about the same value. It is found in Ceylon and elsewhere, wherever corundums are found. Oriental topaz myths undoubtedly refer to this stone, rather than to the true topaz.

The name is singularly appropriate, for even as Pliny's isle was usually lost in fog to the seeking mariners, so may the elusive topaz today bewilder the seeker of his true November birthstone. You "pays your money and you takes your choice," and in most cases it will be citrine quartz.

ARIZONA EXPEDITION

By A. L. Rand

What will explorers do on that not-too-distant day when the last country has been explored? This story of motorized animal photography and behavior experiments in the field suggests new worlds to conquer and shows how Museum expeditionary work carries on in spite of the war

For twelve years or so Mr. Archbold and I have been discovering new animals in the far-flung islands of New Guinea and Madagascar. From our last expedition to New Guinea we described ten new mammals and 40 new birds,—and the work on the collections isn't finished yet. But foreign conditions made this kind of exploration out of the question for the time. We were left with an organization for exploration and no place to explore. It is a situation that will some day confront the whole exploring fraternity, when the map has no more blank spaces.

Many times, in tropical jungles or in alpine grasslands, we had caught glimpses of animals doing something, something that would have required a season of study to understand. But, because our work was to get collections, this was impossible. As we often laughingly put it: "If it's a rare animal, we shoot it; if it's not rare, we leave it and look for one that is." But we still retained an urge to find out how animals lived and why they did things. Now, with our field of exploration closed, it seemed the time to develop our ideas for an expedition to discover facts, rather than things. We knew that we wouldn't have to go far, for there are many, many things unknown about our commonest animals. Mr. Archbold, too, had an interest in portraying the activities of nocturnal animals in color photographs and in developing methods for this that we could use in distant fields.

We decided on southern Arizona for the 1940 season and established headquarters there in the foothills of the Rincon Mountains, near Tucson. We were in the cactus and mesquite country. Back of us were the steep Rincon Mountains with the oaks and pines of the Transition zone; in front of us was the desert plain of the Lower Sonoran zone with its forest of giant cactus, the saguaro, stretching away to the distant mountains.

The Southwest is particularly rich in small mammals. Many of them are called rats or mice. Rats and mice to the laymen are nasty, noisome creatures that haunt closets and pantries. But those are house mice and house rats. They have a whole host of outdoor relatives, cousins many times removed, that are well worth becoming acquainted with. If only these little animals, as graceful in form and as beautiful in color as squirrels, had other names than rats and mice, they would undoubtedly be more attractive and better known. But also, they are shy, nocturnal creatures, not easy to know. There are the kangaroo rats, which make wonderful pets and never try to bite. They hop like little kangaroos, store up food against a time of scarcity, and can exist without drinking, because their body manufactures water from their dry food. They can be kept for months on a diet of dry oatmeal, a diet that will cause even house rats to die from food deficiencies.

There are also the grasshopper mice, tiny creatures that kill and eat prey like a carnivore. There are the deer mice, which are agile climbers; and there are wood rats, which make huge nests armed with cactus spines. These last belong to a group that has gained renown as trade rats, because when they steal an object from a camp they often leave something in exchange. A moral sense has been claimed for this behavior, but the accepted explanation is more prosaic. It is that the rat is already carrying something and when he finds something he likes better, he leaves what he already has. Hence, the trade.

These inhabitants of the Southwest were some of our subjects for close study.

Motorized photography

The many mammals we saw along the road in the headlights of the car as we motored over the desert at night gave Mr. Archbold an idea for night photography. He mounted a motion picture camera with sixteen-inch lenses on a truck, with a battery of lights and a generator to supply them. This outfit permitted mobility and gave a beam of light that lit up the hills for miles around. With this we cruised along the roads, photographing animals caught in the beam of light. The use of Kodachrome film of course necessitated much more light than if we had been using black-and-white film, but the results were worth the extra trouble.

Most of our night photography was done along the road that went through the near-by Saguaro National Monument. Jack rabbits were our best subjects. Both the black-tailed jack and the taller, slimmer, white-sided antelope jack were common here; but it was always the black-tailed jack rabbits that got caught in our lights. They became confused in the glare, hopped this way and that—sometimes right up to the truck—giving excellent opportunities for pictures. Cottontails were of course common but had the annoying habit of scurrying from one clump of prickly pear to another and, though not going far, usually managed to crouch in a shadowy place.

There was one night of rare good luck when a pack of javelinas trotted, with apparent unconcern, across the road in front of the truck. These little peccaries, or wild hogs, push but a short way over the border from Mexico. In fiction they are usually represented in herds of hundreds. Surrounding a hunter who has wounded one of their number, they smash his gun and rip his boots to pieces with their savage tusks as he pulls himself onto an inaccessible ledge of rock. But in Arizona they are one of the shyest animals. They are considered game and have the protection of the law for a closed season.

Irony

Occasionally kangaroo rats darted through the mesquite, but they too usually paused in shadow. So we decided to try a set for them. On a mesquite flat near the ranch house, the largest of the kangaroo rats, the bannertail, had made many burrows and mounds of earth, as is its custom. The many little tracks in the sand showed that the burrows were in use, and the photography truck was set up about 50 yards away. All was made ready to switch on the lights as soon as the animals arrived, and as darkness fell we used hand torches to try to locate them. We saw diamond-icy gleams of spiders' eyes reflected everywhere, and we picked up a night hawk's orange-reflecting eye before we saw the ghostly shapes of the bannertails. The switch was thrown, the generator roared to life, and the whole mesquite became as bright as day. The bannertails seemed to take wing, so far and fast did they leap. Though we waited until midnight, they were too shy to return. Disgusted, we gave it up. At home I turned on my bedroom light,—and there was one of the sought-after rats sitting up in the middle of the floor! In an instant I realized it was a household pet, but there was the fleeting thought of the irony of waiting for kangaroo rats in the desert while they were waiting by my bed.

Photography was only part of our work. In our [illegible] program we had assigned ourselves on the cats. The young of the ring-tailed cat had never been described, and Mr. Richardson set out to do this. This animal's nearest relatives are the raccoons and pandas, though it is somewhat like a small fox. It has a pointed muzzle like that of a fox and a huge ringed tail, the latter a much grander ornament than that of a raccoon. The species being of especial interest. Outdoor wire-mesh cages were constructed, and Richardson set wire cage-traps among the rocky ledges of the mouths of near-by canyons. In these he caught his breeding stock. They did well in the cages, [illegible] and in due time young were born in captivity. They were blind, scantily haired little creatures that even then showed the dark rings on their tails. By bringing two young back to New York with him, Richardson raised them until they were nearly adult, thus obtaining a complete record of their growth.

Instinctive or learned?

Behavior studies were another phase of our work. As to how birds recognize their enemies, whether instinctively, or through learning from their parents, or through experience, there are diversified views; and I worked on this, using the curve-billed thrasher as a subject. It was a common hardy bird, and young ones removed from the nest throve in captivity. The diet finally worked out for them was canned dog and cat ration, and chili and cornmeal. This last was at the suggestion of an old Mexican I had helping look after the birds. It is a staple Mexican diet and is said to be used in raising young mockingbirds in Mexico, where they are kept as cage birds.

At various ages these birds, whose previous experience was limited to their nest and their cage, were tested as to what they feared. They fled from a ring-tailed cat loosed in their cage, and this seemed to indicate an instinctive fear of them. But the birds responded in a very similar manner to a rabbit. An electric train, at rest in their cage, was ignored; but when put in motion, all the birds flew from it. It finally appeared that fear was instinctive, but enemy recognition was not. The birds were afraid of large, strange, moving objects, and it was only through experience that they learned what not to fear.

Some desert quail we raised showed us how an unpleasant personal experience can have a lasting effect on a bird's behavior. I had twelve of these charming chicks, little balls of fluff, and inadvertently left the door of their cage open so that a road runner got in. It ate three of the quail and seized another by the wing, badly breaking the skin before the quail escaped. The effect of this experience was that ever after, this chick was much more excitable than its companions, running to shelter at alarms that the others did not notice. However, mere *witnessing* of the misfortune by the other eight chicks, which we might call vicarious experience, had not affected them.

Bluff plays an important part in fighting in the animal world. The raised hackles of a dog, the displayed crest of a kinglet, the puffing and blowing of a hog-nosed snake, help to intimidate an opponent and thus make actual fighting unnecessary. Our young thrashers had an intimidation display in which the wings were spread, the mouth opened, and a loud cry given. We saw this effectively used against a cactus woodpecker. These little woodpeckers, raised from naked, blind infancy, were always quarreling amongst themselves and with every bird with which they came in contact. But once, when one attacked a thrasher, the latter gave its intimidation display—pure bluff—, and the little woodpecker was startled into leaving it alone.

The look that killed

Often I have heard the figurative expression "scared to death." But I no longer use it, for I saw one of my birds actually scared to death. It was one of two road runners that I had raised from the nest. These birds have an elaborate ceremony used in combating snakes, and to find out how they responded to other enemies I started with a great horned owl. The owl, put into the cage with them, walked toward them. The road runners darted away and fluttered against the wire of the cage. The owl watched in apparent astonishment, then walked about the cage, and the road runners followed it. This was repeated several times and illustrates one of the general rules in bird behavior: the following of a retreating object, the retreat from an approaching object. Finally in retreating from the owl, one road runner went behind a box on the floor of the cage. The owl went up close to the box, on the other side, and stood peering, swinging his head in a circle. The road runner came stalking sedately around the end of the box and met the owl face to face. The road runner simply turned, lay down, squawked, twitched its feathers and died—scared to death.

Our studies on captive birds rewarded us well for our efforts. But as opportunity offered in the field, we found new aspects of the fauna that continually intrigued us. This was an arid country, and for part of the spring the only available water for many miles on these desert flats was found in the man-made reservoirs. Thus the presence of water birds at these ponds, some of them freshly made, came as a surprise. Here, on the spring migration we found coots, cinnamon teal, scaup duck, willet, sandpipers, herons, and egrettes. A flock of snowy egrettes, circling over the giant cactus desert, always impressed me with its incongruity.

Cactus "dormitories"

On a morning ride through the desert I always saw a great many birds' nests. Some of the giant saguaro cactus were riddled with the nest holes of the gilded flicker and the Gila woodpeckers. Of course not all were now occupied by their excavators; some furnished homes for such birds as the elf owls, screech owls, crested flycatchers, and purple martins, but many were empty. It seemed as if the woodpeckers went on making holes far beyond their needs. The little domed stick-nests of the verdins, tiny gray, yellow, and chestnut relatives of the chickadee, were also numerous, and this is understandable when we know that the male also makes a sleeping nest, and that these nests in the stiff branches of desert shrubs endure, even if not used, for more than a season.

The big cactus wrens also make sleeping nests, even the young of the year, and this explained the abundance of these retort-shaped nests, usually in cholla cactus, where the nests remain for more than a season. The abundance of curve-billed thrasher's nests, almost invariably in cholla cactus and in all stages of construction and disintegration, puzzled us at first. Then we found that not only do they have a nest for the eggs and another for the male's sleeping quarters, but the birds may start several nests in a season. In raising additional broods, they shift to one of the nests they have partly completed earlier in the season, while some nests are never used. This further illustrates their well-known relationship with wrens, which habitually make cock or dummy nests. One night we made a flashlight photograph of an incubating thrasher. We knew there was a second nest below the one in which the bird was incubating, but did not think to look at it then. When the plate was developed, we discovered that there was a second bird, presumably the mate, asleep on the other nest.

The antics of a pair of flickers going to bed one night amused me. The male had already chosen the nesting site, and before dark he was accustomed to retire there to sleep. This was before the eggs were laid, and the female usually slept in a near-by hole. But one night he found the female ensconced in the nest hole. She was looking out as he came to the opening. He seemed to seize her by the nape and hustle her out, after which he went in to sleep, leaving his mate to find her own sleeping place. Certainly there is scant chivalry among birds. The male had adhered to the behavior pattern that calls for him to pass the night in the nest cavity.

The phainopepla is a striking, characteristic bird of the Tucson flats, about the size of a cardinal. It has a crest and is shiny black, with big white patches in its wings. It is usually seen sitting conspicuously on the tops of mesquite bushes, or making circular flights that display its colors to advantage. The open country, with sparse shrubbery, allows the birds to be seen from a distance, and the phainopepla's brilliant plumage and open habitat are correlated with its habit of making itself conspicuous by sight to a prospective mate and to rivals, instead of singing as do many other birds.

Arizona brought to the Museum

The new hall of North American Mammals in the American Museum of Natural History offered us an opportunity to bring home a section of this country. One group that we collected portrays the Tucson flats from a place on the slope above Malino Canyon and presents the black-tailed and antelope jack rabbits. The slight elevation chosen for the scene allows a view over the extensive "forests" of saguaro cactus, the most characteristic vegetation here, and Arizona's State flower. Accessories include barrel cactus, yellow flowering paloverde, and the red-flowered ocotillo. Actual specimens were sent to the Museum by air mail, so that flowers would be in the hands of the preparators before they withered. The background will be done from Kodachromes taken on the spot. Across the eastern plains rises the distant jigsaw silhouette of the Tucson Mountains, like cut-outs pasted against the sky. It will not be easy to get the characteristics of the country in the three by three by five-foot space allotted to this group, characteristics that are space and distance.

The time is to be sunset, when the rabbits are out feeding; when red, or orange and gold, typical dry country colors, flood the sky, and the distant hills have turned purple; before the nighthawk begins its bubbling cry, before the screech owl wakes, and just before the eerie thrilly voice of the west—the coyotes' chorus—drifts down from the hills.

The expedition lasted only from January to June, but in the amount of work done it demonstrated to our satisfaction that such an expedition, even if it discovers not a single new animal, can still accomplish a great deal.

The first *Land* Anin

By Alfred S. Romer*

[illegible]

Life had existed in the water for many millions of years before the first backboned animals ventured on land. What lured them to take this epoch-making step? Better food, more air, or greater safety might seem the answer. But the true reason is as astonishing as the fact that the "accident" of their adventure populated the land with the 30,000 species of animals we know today

Fishes have fared well in many ways. As Doctor Gregory pointed out in last month's Natural History, we owe much to these [illegible] [illegible]. In them were developed the basic bodily patterns that have made the backboned animals, or vertebrates, dominant among animal types; and in the course of the ages fishes have evolved a vast array of types which successfully carry on almost every mode of life available for water dwellers.

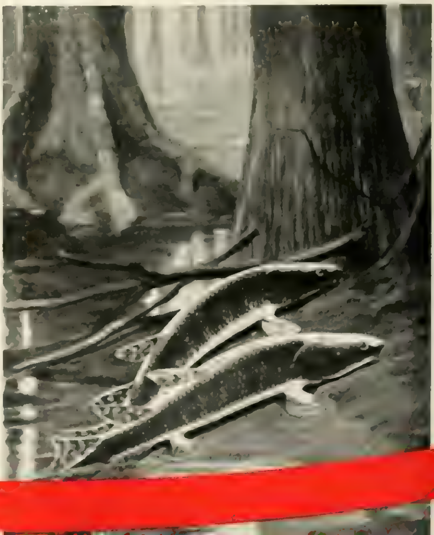
But this is only the beginning of the story. Above the primitive fish lay other and greater opportunities for the vertebrates. Beyond the banks of streams and lakes where our early ancestors swam, lay the land. Plants had already emerged from the water in ancient days to clothe the earth, and primitive insects and a few other lowly animals had also come ashore. The vertebrates were not slow to follow. From the fish stage there developed four-legged land dwellers which, stage by stage, gradually conquered the surface of the earth.

The general nature of the steps, and the evolutionary position of the animal types which were affected were shown in the chart accompanying the preceding article in this series. From the lobe-finned fishes as ancestors there developed the amphibians, inconspicuous today but of vital importance in early times as the first vertebrates to set foot on land. From early amphibians, with the development of a shelled egg capable of being laid on land, came the first reptiles, which had definitely left all traces of a water-dwelling stage behind. Once these first reptiles were firmly established there began a great wave of evolutionary

What happened when fishes first came out on land is vividly revealed in the Redbeds of Texas. These rocks contain the remains of many transitional animals—hang-overs from earlier days and forms hinting of things to come

TIMETABLE OF THE AGES

Eras	Periods	Estimated time since beginning of period (in millions of Years)	Important events
CENOZOIC (Age of Mammals)	Quaternary	1	Man
	Tertiary	60	Rise of mammals
MESOZOIC (Age of Reptiles)	Cretaceous	120	Extinction of great reptiles
	Jurassic	155	First birds
	Triassic	200	First mammals Reptiles differentiate and dominate
PALEO[illegible] (Age of Ancient Life)	[illegible]	225	REDBEDS
	Carboniferous	[illegible]	Amphibians abundant, first reptiles First amphibians
	Devonian	340	Fishes abundant
	Silurian	375	
	[illegible]		First traces of vertebrates
	Cambrian		[illegible] animal types abundant; no vertebrates



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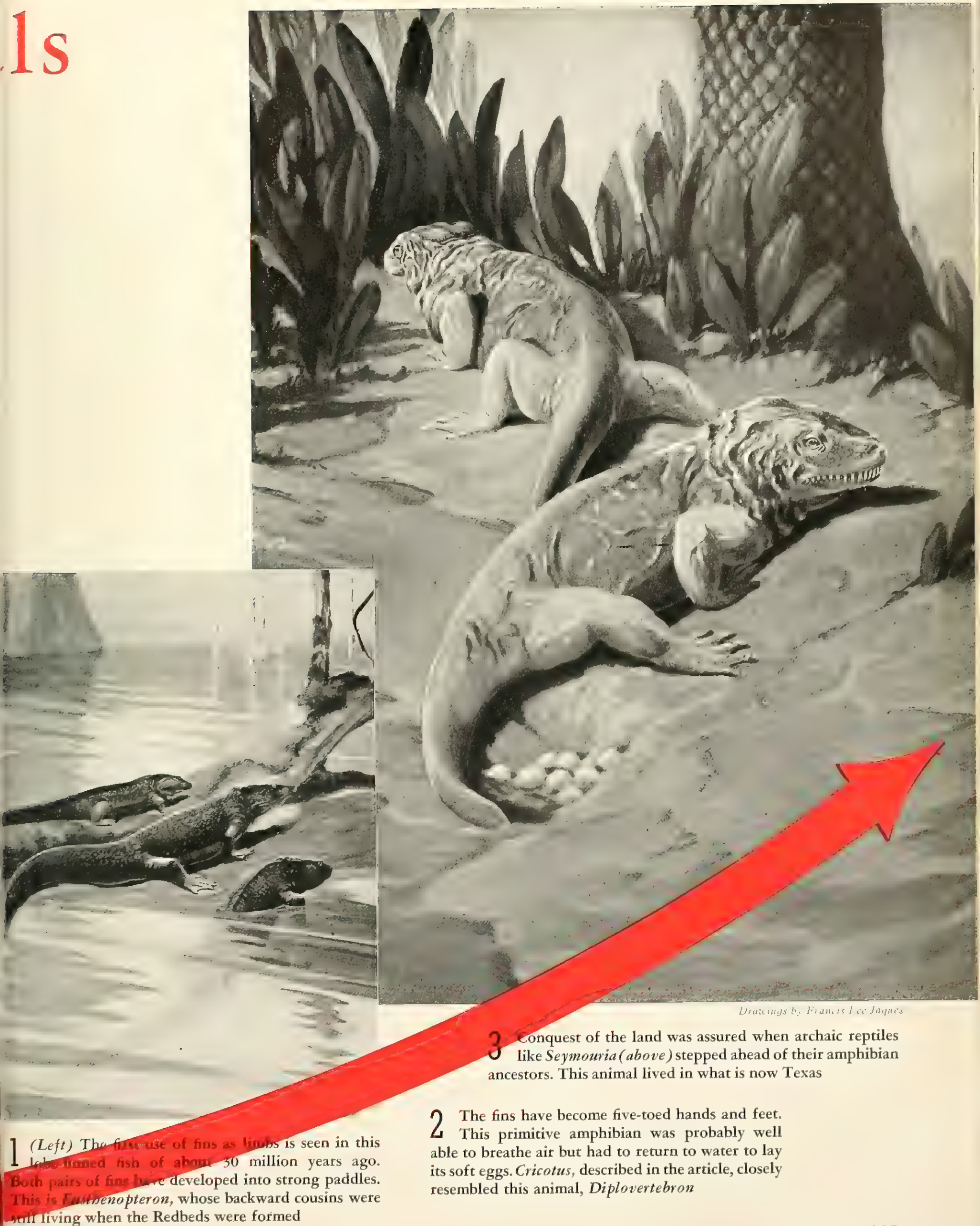
*Doctor Romer is one of the world's leading authorities on the first land animals. He has collected, studied, and described many of them, and has toured America and Europe in this line of scientific investigation. He has for many years explored the Texas Redbeds where this chapter in the early life of our continent has its setting.—Ed.

ls



Drawings by Francis Lee Jaques

1 *(Left)* The first use of fins as limbs is seen in this lobe-finned fish of about 30 million years ago. Both pairs of fins have developed into strong paddles. This is *Eusthenopteron,* whose backward cousins were still living when the Redbeds were formed

3 Conquest of the land was assured when archaic reptiles like *Seymouria (above)* stepped ahead of their amphibian ancestors. This animal lived in what is now Texas

2 The fins have become five-toed hands and feet. This primitive amphibian was probably well able to breathe air but had to return to water to lay its soft eggs. *Cricotus,* described in the article, closely resembled this animal, *Diplovertebron*

[illegible] which resulted in the appearance of the dinosaurs and other spectacular creatures of the Age of Reptiles. And eventually the characteristic birds and mammals of our modern types emerged.

The development of these more advanced types will form the theme of later articles in this series. Here we shall stick to fundamentals. We shall examine some of the early four-footed animals and try to find how and why and in what guise they accomplished that most dramatic step—emergence from the water to the conquest of the land.

For undertaking such an inquiry no better opportunity is afforded than in the early land fossils found in the 250-million-year-old Redbeds of western Texas.

Archer, Baylor, Wichita, Willbarger are the counties whence come the Redbeds fossils; Wichita Falls is the local metropolis; Seymour and Archer City smaller towns, which are often headquarters for Redbeds fossil-hunters. It is a land of rolling, brushy prairies, of great herds of cattle, occasional farms, with here and there a cluster of the oil derricks that have brought much prosperity to the region; a land with some unpleasant features—heat and thirst of a summer and an unpleasant abundance of rattlesnakes,—but on the whole a pleasant country to work in, full of the friendliness and hospitality of the Southwest. Here and there on the hillsides are the breaks for which the collector searches—places where storm waters have washed the earth bare and exposed beneath the soil the underlying clays, shales, and sandstones, often red in color, where fossils may be found.

Bones were first discovered here in pioneer days, two-thirds of a century ago, by old Jacob Boll, a Swiss botanist then teaching in Dallas. Their importance was realized by Professor Cope of Philadelphia, who immediately employed him to explore the field. Boll gave his life in this quest; he was taken ill and died soon after in his tent on the lonely prairie, with only a frightened boy to tend him in his agony. But others soon followed, and the work of many men over several decades gave us a considerable acquaintance with the life of Texas in early days.

Order of events

In the diagram on page 239 is a simplified geologic "timetable," listing successive eras and periods of the world's history. This shows the place of these Redbeds in the sequence of world events and their strategic importance in the study of the conquest of the land. These deposits were laid down at the close of the Carboniferous period (the period when the greatest coal deposits were formed) and the beginning of the succeeding Permian period which marks the end of the Paleozoic era, the Age of Ancient Life. This part of present-day Texas was then not a high prairie but a low-lying delta country, apparently subject to occasional droughts, but covered with a rich vegetation. Across this lowland meandered slow streams, which arose in mountains situated in what is today east Texas and which emptied to the west in a great sea. In these streams and on their banks lived animals of many types, showing every stage in the emergence of vertebrates from water onto land.

Thus, in the Redbeds we find, existing at one time, representatives of a whole series of evolutionary stages,—just as in a single city we see buildings in use which represent different periods in the progress of architecture. There were typical lobe-finned fishes of the sort from which the land animals got their start; there were creatures that lived partly in water and partly on land; and there were even early reptiles, which had left the water entirely.

The fish ancestors of land animals were represented in Redbeds times by a form known as *Megalichthys*, "the big fish" (really not very big, only a foot or two in length). Like his other lobe-finned relatives, *Megalichthys* had what it takes to be the ancestor of a land form,—stout fins with muscles and bones, which needed only to develop further to become the typical leg of a land animal, and well-developed lungs for air breathing. By Redbeds times his cousins had already reached the land as amphibians, the class represented today by frogs and toads, newts and salamanders. But *Megalichthys* himself stayed on as a form old-fashioned even in those days, living for the most part a contented existence in his ancestral streams.

Next in evolutionary order among the animals of the Redbeds we see representatives of the earliest type of four-footed creatures. The advance had occurred a number of millions of years before, but an exceedingly archaic representative of the transitional type was present in the amphibian *Cricotus*. This fellow was an animal of fairly good size, ranging from a yard up to five feet or so in length. In general his appearance was somewhat like that of some of the modern salamanders, with a rather long and slender body, a long tail, and four short and feeble legs. But in internal architecture *Cricotus* was quite different from these living amphibians and in many ways exceedingly similar to his lobe-finned ancestors and relatives. Further, while *Cricotus* had developed land limbs, most of his existence appears still to have been spent in the water. He was potentially a land animal; but in reality this ancestral type of amphibian was little more than a four-legged fish.

How did land life begin? Why did amphibians such as *Cristotus* ever leave the water at all? Why did

Heat, thirst, and the danger of rattlesnakes must be reckoned with in the exploration of the famous Redbeds for the earliest land animals, but the region also offers the hospitality and charm that are characteristic of Texas. This land, now dry, was a low-lying delta country with luxuriant vegetation when the ancestors of all our modern land animals struggled to establish themselves

their ancestors ever develop their fins into limbs capable of locomotion on land? Many answers to this problem have been suggested, but most of them are highly unsatisfactory.

"To escape from enemies," some have said. But the ancestral lobe-fins were among the largest and most aggressive fishes in their native puddles.

"To gain new food supplies," say others. But both early amphibians and their fish ancestors were not vegetarians but eaters of animal food, and there was little animal food on land at the time. There were some primitive insects, to be sure, but so slow and clumsy were the legs of the old amphibians that even an archaic cockroach would have had no difficulty in escaping.

"The lure of atmospheric oxygen" is another fine phrase, but it is pure poppycock as an explanation of the emergence of amphibians. For, as we have seen, the ancestral lobe-fin had competent lungs, and he did not need to leave the water to breathe. By simply lifting his nose to the surface of the pond, he would have the world's oxygen supply at his command gratis.

The real answer to the problem of the development of land limbs appears to be a simple one, although seemingly paradoxical: *legs capable of land locomotion were developed to enable their possessors to stay in the water!*

To visualize the situation, let us compare the type of life led by our friend *Cricotus* with that of his relative *Megalichthys,* who represented the fish stock from which he had come. Both appear to have led, in Redbeds times, much the same sort of life. The fish spent his life in the water, feeding upon minnow-like fishes found in abundance there. So, too, lived the amphibian *Cricotus*. He had legs but apparently used them only a little. Small fishes too were his diet, and like the fish he was essentially a water dweller. Under most circumstances the fish was as well off as the amphibian,—perhaps even a bit better adapted to an aquatic life, for the dangling legs [illegible] would be [illegible]

But it seems that [illegible] in Paleozoic times [illegible] enough [illegible] the [illegible] Permian [illegible] of the earth [illegible] seasonal droughts. In regions plentifully watered at [illegible] rivulets, deep pools would become foul and stagnant [illegible] altogether. What then would be the fate of lobe-finned fishes? For a time, and if the drought were not too severe, all might be well enough. They could come to the surface and take in air to make up for the oxygen absent in the water. Even if the pool in which they found themselves dried up completely, they might burrow into the mud and survive for a time.

But what if the drought were really severe, if the water did not return soon? Under these circumstances the immobilized lobe-fins would soon die.

Not so the amphibian. Under such circumstances his newly-developed legs showed their usefulness. *Cricotus* cared nothing for the land,—it was water he sought; and, unlike his finny cousins, he could seek it. Abandoning the dried-up pool and his dying lobe-finned relatives, he could crawl (although slowly and probably painfully) up or down the stream channels or overland; and then, reaching another pool in which water still remained, he could plunge in and resume his normal aquatic life.

Legs were not, we believe, "invented" as an adaptation for land life, but were a happy accident. Originally, it seems, they were merely an adaptation to help the fish-like animals that bore them to survive drought.

Cricotus, then, represents a first stage in amphibian evolution. By Redbeds days other members of the group had branched out greatly and passed far beyond his primitive level toward a true land life. For example, there was *Eryops*, who was a common Redbeds amphibian—a large form, six feet or more in length, powerfully built and having massive, if rather short, legs. *Eryops* may have been to some extent aquatic, but he probably spent much of his life ashore; and other amphibians of his time may have lived almost entirely on land.

Yet chained to the water

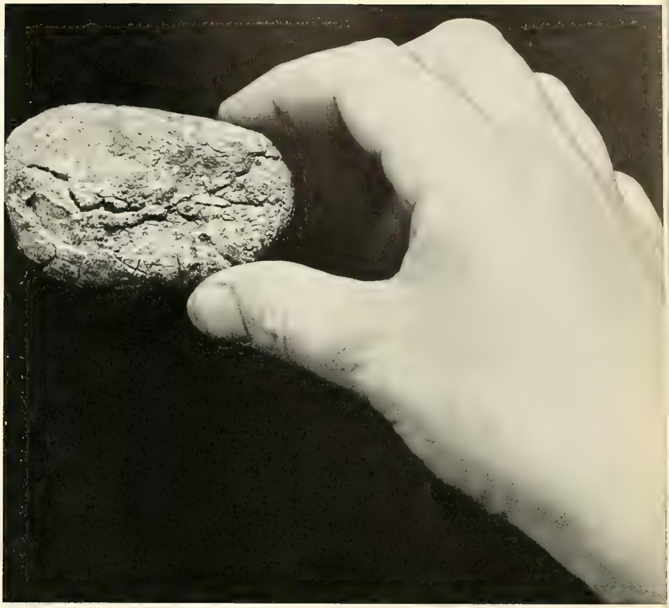
Almost entirely, but never completely. And here lies the reason for the eventual failure of the amphibians as land dwellers. The fault lies in their old-fashioned reproductive habits. A fish's eggs are, of course, laid in the water. So, too, are those of typical amphibians. Each year (as today among the frogs and newts) all amphibians must return to the water to lay and fertilize their eggs. The young, as is easy to see in the case of frog tadpoles, pass their early days as purely water animals, using gills for breathing and eating aquatic food. Then comes a violent change, a metamorphosis—the gills shrivel, lungs and legs develop, and many internal organs undergo marked reorganization: the tadpole changes into an adult which can exist on land. But even so, the adaptation to the land can never be complete, for the grown amphibian must be able to return annually to the water for breeding purposes.

This sort of thing is obviously highly inefficient Suppose, for example, that the reader's car had to be so designed as to be used also as a motorboat. Such a machine can be made, but it would be expensive, inefficient for either line of work, and would probably have difficulty competing with either a proper boat or an ordinary automobile in its proper medium. So with the amphibians. Though able to survive drought conditions such as existed in the early days of the group, they are not remarkably good performers in the water. And the reptiles which arose soon after them are far better adapted for life on land. Faced with keen competition in both environments, the amphibians quite understandably became a "discouraged" group, greatly reduced in numbers, until today they constitute but an insignificant element in vertebrate life. The land they have almost entirely abandoned. At present a few toads range far afield, but most amphibians cling close to the banks, and some salamanders have slumped backward to a state in which they never emerge from the water.

Signs of such degeneracy were present even in Redbeds days, when amphibians were still fairly abundant. An example is ***Diplocaulus***, seen at the water's edge in the illustration reproduced on page 243. This grotesque little creature had a broad, flat body and a flat and ponderous head. The limbs were so tiny that they could hardly have lifted the head above the water and surely could not have carried the animal about on land. Such a form was only fitted for a permanently aquatic life, and presumably it spent its days as a mud-grubber in pond bottoms.

The late Sherwood Anderson once entitled a short story "The Triumph of the Egg." This would be a fitting title for the story of the development of the reptiles, which had originated from a progressive amphibian stock shortly before the Redbeds times. In the Redbeds are very primitive stem reptiles (cotylosaurs), best typified by *Seymouria* (named for the county seat of Seymour near which its remains have been found). *Seymouria* was a rather small and stockily built little fellow *(see illustration*

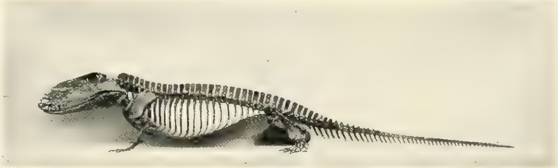
The Oldest Known Egg



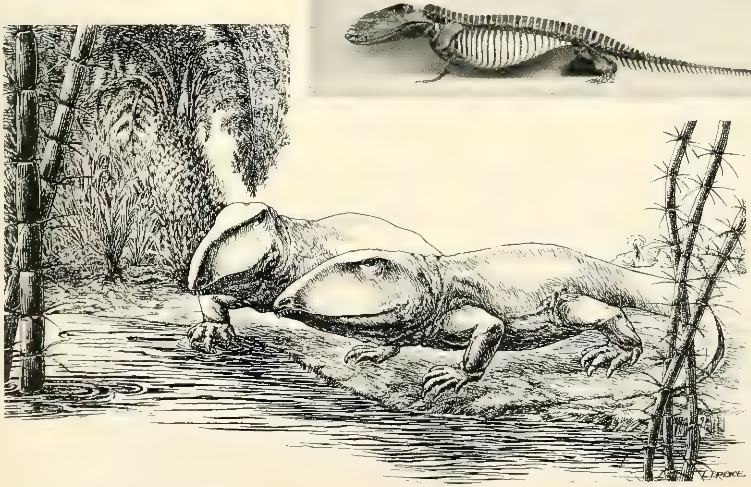
THE KEY TO PERMANENT LIFE ON LAND: the earliest and only true egg from the Redbeds. The amphibians, though able to live on land, were obliged to return to water to lay their eggs, which had no shell to protect the delicate embryo within from drying up. This fossilized egg, discovered half a dozen years ago by a keen-eyed collector, Llewellyn Price, epitomizes one of the most dramatic chapters in the conquest of the land. Possessing a protective shell, it represents the basic patent which enabled animals to break the chain tying them to the water. The method of giving birth to living young was a still later development

(Below) THE SKELETON of *Ophiacodon,* reconstructed from the preserved bones. Here we have a primitive reptile which, however, had feet and skull that foreshadowed the emergence of mammals, the dominant class of animals inhabiting the earth today

Geo. Nelson photo



A PRIMITIVE ANCESTOR OF THE MAMMALS. Certain of the reptiles, like *Ophiacodon* below, led the way in the direction of our vast assemblage of familiar four-footed animals of forest and field



From Prehistoric Life, *by P. E. Raymond, Harvard University Press*

[illegible]

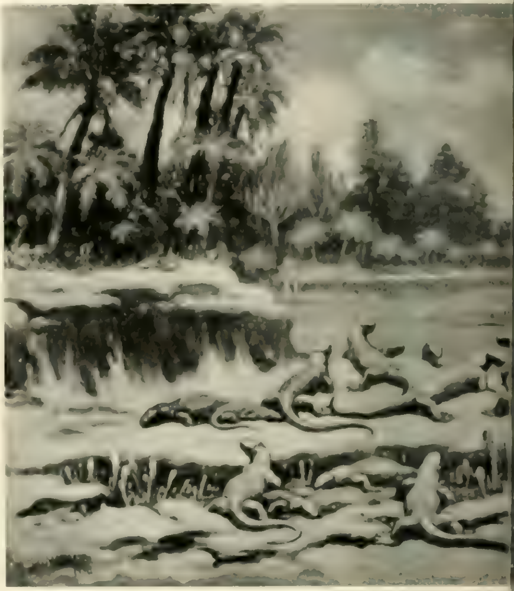
[illegible] actual reason for the success of the reptiles over the amphibians lie not in the build of the adult body but in the methods of reproduction. The amphibian, as a fish, lays its eggs in the water. Since the young must develop there, and since the adult must periodically return there for the egg-laying season, the amphibian can never become a purely terrestrial animal. Not so the reptile. For in this group there has been evolved a new type of egg, which can be laid on land. This sort of egg is still laid by turtles and many a lizard and snake today. It is still present in even a few mammals (although most now bear their young alive); and it is found on our breakfast tables in the enlarged form adopted by the reptiles' avian descendants. The egg is protected externally by a shell which is absent in amphibians. The shell, although firm, is porous; thus oxygen may enter and allow the growing embryo to "breathe." Within the shell a series of liquid-filled membranes gives additional protection to the young and prevents it from drying up. Still further, to supply the food which the encased youngster now cannot gather for itself, much of the egg is composed of a nourishing yolk. So equipped, the tiny germ inside the egg can skip the tadpole stage entirely and grow within its protecting shell and then comes to a point where, on hatching, it can at once take up an existence on land. By the shell-covered egg, the reptile has been emancipated from the water and can now become completely adapted to terrestrial life.

Oldest known egg

We have long felt confident that such a type of egg had been developed by the Redbeds animals that we characterize as reptiles. But fossil eggs are rare, although many a cobblestone in fossil deposits looks like such an object. The first—and only—true egg from these beds was discovered half a dozen years ago by a keen-eyed collector, Llewellyn Price, who immediately recognized its nature and importance. It is a small, oval, iron-stained mass, not at all exciting to look at. But its battered and cracked surface shows tiny patterns of the sort seen on many reptile eggs, and the microscopic structure shows definitely that this surface is an egg shell. This is the oldest known vertebrate egg—approximately twice as old as the famous and more abundant but relatively recent dinosaur eggs from Mongolia (*see photograph page 241*).

Once finally released from the water, there began the spectacular evolutionary development of the reptiles and their descendants. Even in Redbeds times we see the beginnings of this reptilian radiation. And, most interestingly, the commonest reptiles of those early days (pelycosaurs) even showed the beginning of mammal-like tendencies.

Sails! A short lived evolutionary experiment among the early land animals was the development of peculiar extensions of the back among the reptiles known as pelycosaurs. This scene, reconstructed from scientific sources by the well known artist Charles R. Knight, vividly shows the Texas landscape as it appeared a little over 200 million years ago. Two forms of "sail-carrying" reptiles are illustrated, *Edaphosaurus*, whose spines were shorter and had knobby side-branches, and *Dimetrodon*, whose "sail" was supported on long, smooth spines. Whether these animals went sailing around their prehistoric lakes with these appendages cannot be said. But, as any sailor knows, if they floated with the "sails" projecting above the water, they would most certainly have had to reckon with the wind



The mammals, the warm-blooded, hair-bearing and intelligent animals that include man among their members, are such progressive forms that one might think that they developed late in the history of reptilian life. The reverse is actually true. As will be noted from our geological timetable, the first mammals appeared as early as did the dinosaurs. Advanced, very mammal-like reptiles were present at the beginning of Mesozoic days, and in Redbeds times their ancestors, as pelycosaurs, had already branched off from the main line of orthodox reptilian evolution.

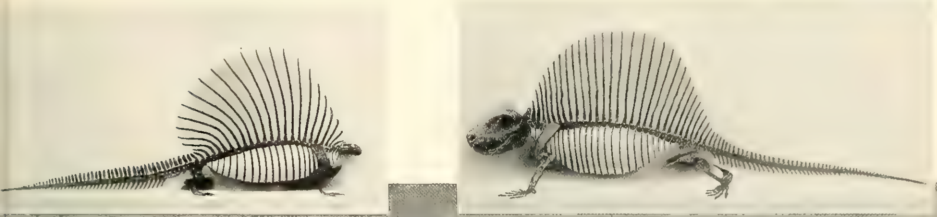
Typical members of these primitive mammal ancestors are such forms as *Ophiacodon (page 241)*. This reptile was still very archaic, still very close to the primitive reptile type. He was, however, a bit slimmer, a bit longer-legged, and in details of feet and skull he shows the first faint traces of characteristics which later emerged full-fledged in the mammals.

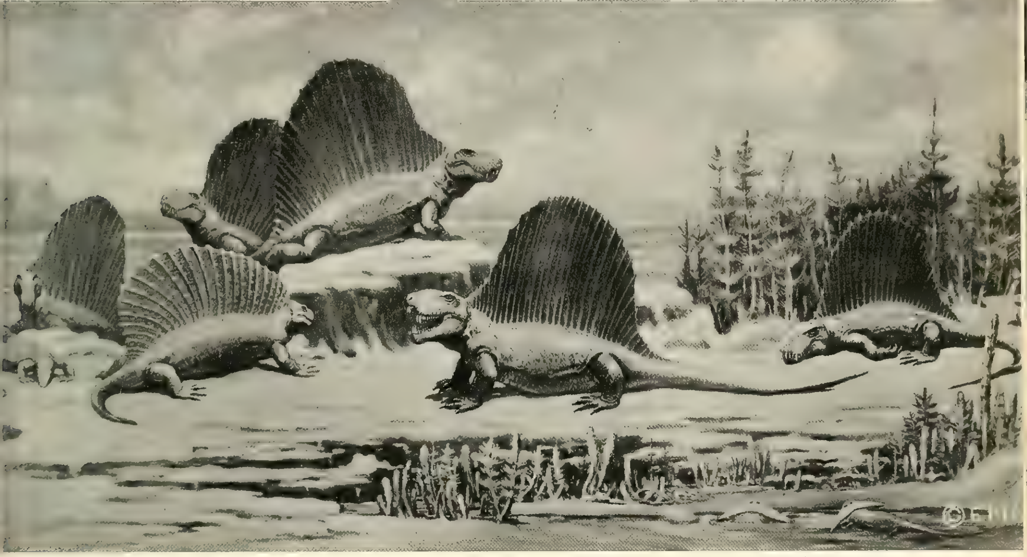
Evolutionary experiments

No group of animals ever kept solely to an evolutionary main line; always there occur side branches, varied, short-lived "experiments." Among the pely-

The reconstructed skeletons of these "sail-carrying" reptiles are shown below. At extreme left in the painting is a small reptile of the time, named *Casea.* At the water's edge at lower right, the grotesque little amphibian, *Diplocaulus,* raises its ponderous head above the water; its limbs were too weak to carry it about on land

Geo. Nelson photos





Field Museum photo

cosaurs such development resulted in the appearance of reptiles with peculiar "sails." The bones which cap the back in any ordinary animal grew upward as long spines between which, we believe, there stretched a continuous covering of skin. Two such types are shown in a mural by Charles R. Knight *(see illustration).* In one *(Dimetrodon)* the spines supporting the "sail" are long but smooth, slender rods; in a second *(Edaphosaurus)* the spines are shorter but with knobby side branches that have been compared with the yardarms of a ship. The purpose, if any, of this peculiar type development is quite unknown. The original describer of these forms suggested facetiously that these reptiles went sailing about the Redbeds lake with them. This idea is not better but also no worse than any other that has been advanced.

Redbeds animals were not as big as those of later days. Although some of them are rather peculiar in build, they lack for the most part the "glamour" of some of their more advanced and spectacular descendants in later geologic periods. My brethren in the bone-hunting game may have their dinosaurs or what not; the writer, at any rate, prefers these older fossils. The study of Redbeds animals is a difficult and tantalizing process. Collecting them is often a dreary task, fraught with heat, thirst, and discouragement. But these ancient fossils are important and their collection well worth the trouble. Land dwellers have progressed far beyond the condition of their crude and ungainly Redbeds ancestors. But the first steps in any process are the most important ones; and, both literally and figuratively, the first steps in land life are revealed to us through the animals of these ancient beds of the Southwest.

A MODERN GULLIVER

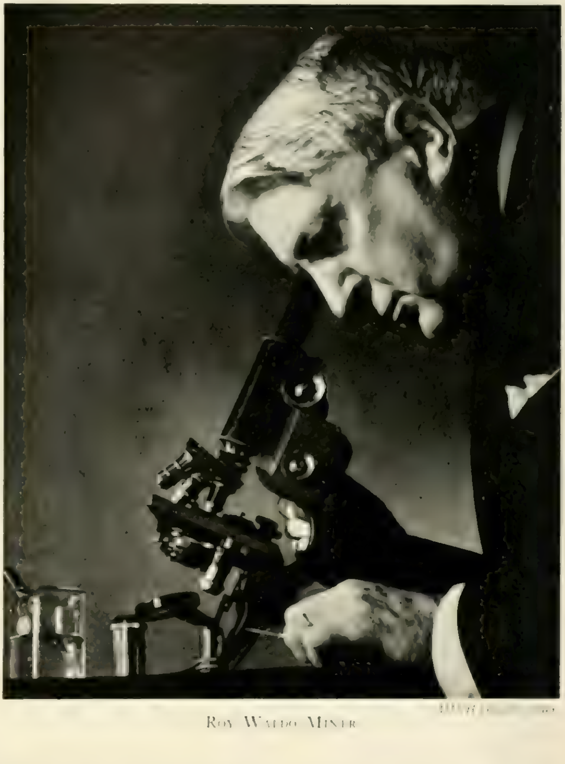
As Curator of Living Invertebrates, which comprise eleven-twelfths of the animal kingdom, Roy Waldo Miner shuttles back and forth between the fascinating intricacies of a microscopic Lilliput and the overpowering grandeur of Coral Seas

By D. R. Barton

M[illegible] Hall of Ocean Life [illegible] far end. There stands the Bahaman Coral Reef Group, one of the most complicated exhibits ever attempted [illegible] dollars, and probably more equipment and assorted brain power than any other project in the history of the in[illegible] glass forms the front of the exhibit. More than half way to the top, a balcony spans the show case horizontally. The balcony itself simulates the deck of a yacht anchored in warm B[illegible]n waters. A [illegible] ground by Frances Lee Jaques* shows huge, billowing clouds, pink flamingos and wind-blown palms, all in the path of the trade winds, which shape the entire topography in an east-to-west direction. But this is merely the beginning. We have only to descend the stairway to be confronted by 30 feet of ocean floor in living color. Here the giant elk horn coral gives colorful variety to the scene. Feathery, trailing gorgonians float upward and delicately tinted fishes dart out from the shadowy waters between the formations of coral and sponges which have been restored to natural colors and arranged in the same positions they occupied when five Museum Bahaman expeditions were sent out to find them.

Almost everyone knows the astonishing fact that over 40 tons of living coral were dredged from the ocean floor and put into this single exhibition case, a tour de force involving eight and one-half tons of iron work and some remarkable feats of engineering. For this group had no recipe. It was something that had never been done before, and the difficulties arising from the fact that the stresses and strains under water are not the [illegible] worked out by Doctor Miner and his [illegible]

Nearby, a companion exhibit has recently been completed. This is the Pearl Divers Group, based on investigations around the South Sea island of Tongareva. A spectacular display, it contains ten and one-half tons of coral, re-tinted and composed into the exact position from which it was wrenched from the Tongarevan lagoon at a place where the precious pearl shell grows luxuriantly. Together, these two exhibits are the embodiment of the prolonged labor of so many highly skilled individuals that some believe that their complexity will not be equalled in the Museum for years to come.



Roy Waldo Miner

Roy Waldo Miner, the man who made them possible, has spent a fair share of the last two decades under water, gliding eerily along tropical sea bottoms, looking for just the proper settings and specimens. He has braved death in the shape of man-eating sharks, moray eels, octopuses,

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[illegible]

barracuda, and huge sixteen-armed starfishes equipped with poisonous spines. As with all the other lethal denizens of the deep, Doctor Miner knows one of the latter when he sees it, and treads warily. However, if he ever had taken a false step, native divers claim that the sea star could easily have been made to repair its ravages. Their advice is to flip this sea-bottom hedgehog over on its back and let the powerful suckers go to work on the wound before the poison spines have had a chance to worm their way into the blood stream. Fortunately, Doctor Miner never had to test the efficacy of this remedy, but he did once narrowly escape an altercation with a quartet of sharks by following another of the natives' helpful hints. The incident occurred in a coral "cave," 25 feet down, where Miner was busily snapping pictures with a special waterproof camera (one of the less arduous preliminaries to building coral reef groups). The sharks, who entered via the only exit, displayed the keenest interest in this unusual performance and, in fact, became so brazenly curious that Miner was forced to stake all on the wisdom of the native diver's formula which is to lunge at the man-eaters, threateningly swishing the arms. It worked. The inquisitive sharks turned tail and huffily swam away. But Doctor Miner hates to think what would have happened if they'd called his bluff, and he refuses to endorse the formula as foolproof. So if you swish a threatening arm—and lose it—don't sue.

To discover why Doctor Miner gets himself into such fixes, we must go back to the day a gathering of Museum officials were knitting their brows at one end of the Hall of Ocean Life wondering what, apart from the already superabundant whales, they were going to use to fill the vast space at the other end. On being consulted, Miner suggested a coral habitat group. For, while the coral polyp may be one of the smallest sea creatures, its ramifying structures of living rock reach staggering proportions. The Australian barrier reef, for example, is 1400 miles long. Much as he would like to, Miner could not promise to bring this living mountain ridge back to the Museum, but he was quite confident that something perfectly adequate to the specifications of the Hall could be found nearer home on Andros Island in the Bahamas. He submitted plans, models and—a budget. It looked like a big job. But he put himself on the spot by guaranteeing success. Thus dangers and discomforts could not be allowed to stand in his way.

A Bumpus protégé

Though he has engaged in such bizarre tricks of the trade as stunning tropical butterfly fish underwater with an elaborate cap gun attached to a bamboo pole,[*] Roy Miner started out with much less startling ideas in mind. Like his illustrious colleague and erstwhile professor, William K. Gregory,[†] Roy was early destined for the Episcopal ministry. Son of a renowned classical scholar, and younger brother of a clergyman, he grew up amid a scholarly New England atmosphere in North Adams. At Williams, where he was a member of the class of '97, he studied the classics and sciences in equal amounts, scoring high grades in both, but leaning slightly in the direction of biology, partly owing to the inspired teaching of Dr. James Ingraham Peck, who persuaded him to take a summer course at Woods Hole Marine Laboratory. This was, Doctor Miner recollects, "an eye opener." So enthusiastic a student did he become of all the marine forms of life, and so diligent was his work, that he quickly attracted the attention of Dr. Harmon C. Bumpus, one of the outstanding zoologists of that day. Seven years later when Miner walked into the director's office at the American Museum, Doctor Bumpus remembered him instantly and at once put him to work on a part-time basis. Miner's subsequent activities raised Bumpus' already high estimation of his skill as a biologist, and before long the Director induced the young man to give up teaching for a permanent post on the Museum Staff.

During the years leading up to this offer, Miner had gone through the Theological Seminary, passed his canonical examinations with flying colors, and then made up his mind against the ecclesiastical way of life. At loose ends, he decided to market his fund of classical and scientific information at the Berkeley School for Boys in New York. There he met up with another teacher who wanted to start a school of his own, and Miner joined forces with him. Together they opened the Kelvin School, Miner handling the biological sciences and classics as before. Even today his proficiency at Latin is the envy and wonder of his curatorial colleagues. Though he has not taught for 30 years, he can still reel off in five minutes, a lengthy English translation that would cost his associates many hours of brain-cudgeling and dictionary thumbing.

His first job at the Museum put him directly on the road to his most spectacular success in later life, for he was assigned to the coral collections and spent a good deal of time on identification and reorganization of the material. But young Miner was a long way from specializing in this or any other field. In those days the Museum was not nearly so departmentalized as now, and the Invertebrate Section, of which he became Assistant Curator under William Morton Wheeler, was obliged to concern itself with a motley array of scientific material and equipment including amphibia, reptiles, forestry, and last but not the least curious of all—scientific instruments. However, Miner's tastes in scholarship had always been on a catholic scale and he wasn't even slightly perturbed to be set to work counting all the rings on all the specimens of trees in the Forestry Hall. Just as he had enjoyed the minutiae of Hebrew manuscript comparisons at the Theological Seminary, he now took delight in organizing detailed data to be handed over to the Forestry Department when that division of Museum activity at last came into being. This penchant for painstaking spadework is characteristic of Doctor Miner. Even in his present executive capacity, he likes to do everything he possibly can himself.

Nor were trees his only avocation during these early years. A fine all-round biologist, he worked a good deal with vertebrates and later actually wrote his doctor's thesis on one of them.[‡] But though he had previously done some mammal dissection for the Preparations Department, fish were the particular life form that came under his scrutiny, and he became so accomplished a student of their ways that Bumpus asked him to choose between continuing as Associate in Invertebrates or becoming

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[*] This is the only way to catch them alive so that the gorgeous radiance of their natural colors can be recorded by an artist before they fade.

[†] *See also* D. R. Barton, "The Evolution of an Evolutionist," NATURAL HISTORY, April, 1941, 234.

[‡] *The Pectoral Limb Musculature of Eryops.*

[illegible]

[illegible]

[illegible] fact that the latter wound up in a [illegible] both competed for an essay prize of- [illegible] written at Bumpus' suggestion shortly after Miner had supervised this Museum's first public display of the finny tribe.

Though his undoubted talents as an ichthyologist were never put to the supreme test, Miner has proved [illegible] ter of Museum "showmanship." Axiomatic in curatorial credos is the tenet that executive duties, including those of public instruction, consume a man's research time. Yet Miner has tackled many of the "internal" study problems of his department singlehanded, is on intimate terms with the projects of all his assistants and keeps up with the latest publications in the field without slackening [illegible] the external work—the public exhibitions.

Unique among the curators in possessing a full-fledged preparations department of his own, Miner is a Museum version of the Hollywood writer-director-producer. A benign Svengali, he has the knack of bringing his own dreams to fruition by evoking the best in others. And all the magnificent displays in the Ocean Life and Darwin Halls are glowing testimony to this gift.

The artists and technicians under Miner's direction have changed from time to time over the years, but three [illegible] hardy perennials' have received attention in these pages and a fourth, Chris Olsen, whom Doctor Miner justly terms his right-hand man is already well-known to readers of this Magazine and the public at large, as the man who paints pictures under 20 feet of water with weighted brushes, in order to preserve the exact coloring of the undersea conditions which he must reproduce on [illegible] coral specimens themselves. For coral [illegible] must be carefully re-tinted prior to its installation within a group. In fact nearly all color in these large groups is restored artificially, which helps to explain the number of artists required.

Olsen may well be termed Doctor Miner's Man Friday of Brobdingnag, but his Trilby of Lilliput is Herman Mueller, whose lung power and wondrously manipulative fingers have wrought the rotifers and other creatures living in one-half inch of ordinary fresh water pond bottom into a magical glass blower's world magnified one million times by cubical measurement. Working from drawings made by Dr. George Childs under Doctor Miner's direction, after careful microscopic study, Mueller has created for the admiration and instruction of all, the ecological situation of several species of rotifers, including those which, as Doctor Miner describes them, "build beautiful tube-shaped homes for themselves of spherical bricks of transparent mucus." Many of these creatures are so small that a whole colony could occupy a pinhead, yet some individuals in Mueller's reconstructions are as large as a young lobster. Under Miner's direction, Mueller has spent the better part of 35 years immortalizing these popularly neglected animalcules and many other lowly forms of life. And the result cannot be duplicated for accuracy and beauty anywhere else in the world. All during their long association the scientist has worked with collecting apparatus and microscope to find something the glass blower could not reproduce, but he has never yet succeeded. Miner's fame would remain secure on the score of this particular Trilby alone. But there are other singers in the cast—George Childs, for example, who devotes an entire year to making a single model of a worm. The anatomy of sea worms is bewilderingly complex to the human eye, and Miner, with his flair for teaching, developed an arbitrary color key for Childs to work on—black for nerves, chrome yellow for digestive tracts, etc., which resulted in modeled replicas of startling clarity for public instruction. "Thus our artists," Miner has remarked, "are the organ keys upon [illegible]

Eleven-ring circus

Miner is never at a loss to invent some pardonable "improvement" on Nature. Nor is he reluctant to accept the suggestions of his aides-de-camp along these lines, though strict adherence to naturalistic detail is inevitably the order of the day and Miner will tolerate no newfangled "impressionism." Cramming 30-odd tons of coral into a 15' x 30' x 12' space and having it look like sea bottom demands a little compromise somewhere—the miracle is, it's so slight. Indeed that goes for all the features in Miner's show, which is really not a three- but an eleven-ring circus, owing to the fact that his department is responsible for all but one of the twelve phyla (major groups) into which the entire animal kingdom is divided.

In 1909, Doctor Miner was placed in full control of the exhibition work in Darwin Hall, wherein he had been a participant for some time. Under his direction, work on the alcove models of all twelve phyla was pushed forward and the window groups begun. The latter—seven in number—represent not only the first pioneer attempts to create three-dimensional, life-like groups of the humble marine organisms, but the most successful achievements to date in the interpretation of the intimate relationship between organism and environment along our shores.

Long before blueprints and drawings, diagrams, and charts, could be handed over to his adjutants, Miner had to collect all the data together with hundreds of specimens on the coasts of Maine, Massachusetts, and Long Island. This Hall is a triumph of visual instruction, and student, layman, and specialist alike have profited by visiting its cool alcoves. The fact that Miner was working on the microscopic Rotifer Group and the huge Coral Reef Group at the same time caused him to comment on the Gulliver-like psychological somersaults which he was compelled to perform in the course of an ordinary day's work. It also stimulated him to pen his philosophy of size:

"Size is an important factor to many people. An elephant is imposing because of its bulky stature, and when met in the wild state in the jungle, it appears dangerous to men and a

[illegible]

[illegible]

YOUR NEW BOOKS

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PEATTIE'S SELF-PORTRAIT ● PLAGUE ON US ● MINERALS
CHEROKEE MARTYR ● HAWAIIAN MYTH AND HISTORY ● BIRDS

RIVER OF RUINS

- - - - - - by Louis J. Halle, Jr.

Holt, $3.00

RIVER OF RUINS is a travel book. It is an account of travel in the forests of the Petén district of Guatemala and the state of Chiapas in Mexico. There is an abundance of adventure and hardship, but there is nothing conventional in this pattern of incident and scene. Louis Halle has a deeply cultivated mind, and he can write the king's English. The result is a book which combines vigorous and humorously burly adventure with an infinitely charming intellectual reaction.

Mr. Halle and his friend Tom Gladwin set forth to visit this little-known part of Middle America to seek ruins and collect birds. They found the ruins, but the insects prevented their amassing ornithological specimens. Thus, to the record of adventure Mr. Halle has added not only the fresh impressions of a field naturalist regarding the flora and fauna of the region, but also the unsentimental and unromantic accuracy of a historian when describing the ruined cities of the Maya.

River of Ruins is a distinguished addition to the growing corpus of books on Latin America. It is especially important in that it brings the literary approach to a field dominated by flatulent journalese and desiccated technical writing. I cannot recommend too warmly *River of Ruins*.

GEORGE C. VAILLANT.

BIOGRAPHY OF THE EARTH, ITS PAST, PRESENT AND FUTURE

- - - - - - - - by George Gamow

Viking, $3.00

DOCTOR GAMOW, Professor of Theoretical Physics at George Washington University, and author of *The Birth and Death of the Sun* has produced a work that is unique among the popular accounts of earth history. Most authors of books upon this subject devote an opening chapter to the problems and theories of the origin of the earth, and immediately turn to the discussion of the later eras where the sequence of events and the evolution of life is well-known and documented. Doctor Gamow has completely reversed this emphasis, one-third of his book is devoted to the origin of the planets (including the earth) and to the "birth" of the moon. Only one chapter (less than 40 pages) is devoted to life on the earth, and more than one-third of this chapter is concerned with the problems of the origin of life itself. The entire paleontologic record is summarized in about eighteen pages. The remaining pages are concerned with the internal constitution of our planet, with the origin and evolution of the continents, and with a discussion of the future of the earth and the solar system.

It is this reversal from the usual distribution of subject emphasis that makes this work valuable and important to the student of earth history and to the well-informed reader. Doctor Gamow, a theoretical physicist, has contributed to research on problems of the solar system, and because of this scientific interest is admirably equipped to discuss the theories and problems of the earth's formative years. And this discussion is a very real contribution. Unfortunately, however, Doctor Gamow is not a paleontologist, and the pages devoted to the fossil record contain many errors. Most of them are not of great significance, but they are, nevertheless, most regrettable in a work which otherwise is so valuable.

H. E. VOKES.

THE ROAD OF A NATURALIST

- - - by Donald Culross Peattie

Houghton Mifflin, $3.00

MR. PEATTIE'S most recent volume is something less than an autobiography and something more than a collection of essays on nature, and yet it forms a coherent whole. The non-biographical text shows us the author's thoughts, which are as much a part of the man as the briefer paragraphs about his life. Each digression falls naturally into place in relation to the particular epoch of the author's career that brings it into view.

Thus, a short review of the life of the young naturalist, Robert Kennicott, is a logical corollary of the Peatties' return to live at Kennicott's Grove. The story of the fearful crossing of Death Valley by the forty-niners finds an entry with a visit to the Mohave Desert, as does a discussion of the rôle of the Pronuba moth in the fertilization of yucca flowers.

There are many such side journeys; in fact, they form the bulk of the volume. There is the story of Michaux's discovery of the little plant, *Shortia*, lost again for 99 years and a day, when it was discovered by Professor Sargent. There are comparisons of the vast evergreen forests of the West with the hardwoods of the East, and impressions of the life of the intervening prairies. There is note of the once vast flights of passenger pigeons, of the California redwoods, of the persecution of the Pacific sea otters, and of the activities of the eggers on the Farallones. There are the stories of Coronado's search for Quivira, and of C. V. Riley's pioneering in the science of economic entomology. There is a chapter on the evolution of nature writers, their place in the scheme of things, and their relationship to the research scientists on whom they must depend for the facts they popularize. Through it all runs the author's philosophy of life.

So, although we are told only scattered bits of personal history, and these not always chronologically, in the end we have a picture of the author drawn by his own hand, against his chosen background,—a self-portrait rather than an autobiography.

JOHN T. ZIMMER.

PLAGUE ON US

- - - - - - - - by Geddes Smith

The Commonwealth Fund,

41 East 57th St., New York, N. Y., $3.00

IT is a pleasure to recommend Geddes Smith's book, *Plague on Us*. In recent years, there have been a number of popular and semipopular volumes on the vast subject of the valiant fight of man against the agents of infection. Many of these books were written in an over-spirited manner in hope of engaging the attention of the reader in what the writers must have originally considered a dull subject, otherwise they would not have deemed necessary the "injections" they supply. But Geddes Smith, whose attractive literary style for some reason reminds us of the *Education of Henry Adams*, has gathered together a vast fund of information concerning the infectious diseases and how they are spread, in a way that engages the attention of the reader from first to last. Heretofore complicated subjects, such as the mechanism of the fight of the human body against invasion by disease-producing agents, have been simplified by Mr. Smith's sheer charm of writing.

The how and why of epidemics, much of which still remains a deep mystery, is explained so clearly that even one without any previous training in medicine will be in possession of the pertinent facts as far as they are known. Therefore, *Plague on Us* can be read with enjoyment not alone by the intelligent layman but also by those who are preparing to specialize in the field.

Mr. Smith has taken pains to record

[illegible]

Margaret C. K[illegible]

DANA'S MANUAL OF MINERALOGY Fifteenth Edition

Revised by C. S. Hurlbut

Wiley [illegible]

THE [illegible] Dana's Manual of Mineralogy, revised by Dr. C. S. Hurlbut [illegible] eliminates nine-tenths of the amateur's [illegible] locality only a few minerals with generally [illegible] 100 minerals are eliminated, and determinative tests made for but one or two.

The needs of the collector are twofold, he must learn about his minerals and he must have confidence in his authorities. Too many books are written by other amateurs who lack the background of experience [illegible] knowledge. Here is one which is unimpeachable. J. D. Dana, the author, and W. E. Ford, the earlier reviser, were foremost authorities; and the present reviser, Dr. C. S. Hurlbut, Professor of Mineralogy at Harvard University, carries on the tradition most creditably. For the amateur and the student the [illegible] unequalled by any other and occupying a niche of its own. This revision of an old work should not be neglected by collectors for newer but far less valuable books.

F. H. Pough

TWENTIETH CENTURY INDIANS

by Frances Cooke Macgregor

Putnam, $3.00

THERE is gradually growing in North America an appreciation of our first settlers, the Indians. A steady stream of nontechnical books has flowed into the [illegible] different. Many of these excellent volumes [illegible]

Mrs. Macgregor [illegible] cent and future of the Indian without [illegible] than Dr. Clark Wissler.

Mrs. Macgregor [illegible] temporary position of the Indians and the problems they face to survive in our modern world. The reservation life, imposed by the whites, at first tended to reduce their numbers, but in the last half century has enabled their population to increase. However, the various types of social order and material culture which were adequate for the Indian's existence under pre-Columbian conditions, have become largely [illegible] in terms of white standards. Mrs. Macgregor, in photograph and text, drives the point home that economic conditions, which would melt our hearts when endured by whites, are rather far above the lot of many of our Indian groups, sequestered under the loving care of the Great White Father.

We know that the zoological park and [illegible] for conservation of natural resources. The Indian Bureau is beginning to work out means for conserving the human resources of our Indians and to depart from the zoo technique of the old-line reservation. Mrs. Macgregor has set forth the plight of the modern Indian without wailing and gnashing of teeth. She has pictured the fortitude of the Indians who maintain an unfaltering way of life in adversity. Despite the gloomy cast of this review, her book presents a lively, even charming, view of our modern Indians. *Twentieth Century Indians* should take its place among the foundation books for general knowledge of our Indian tribes and cultures.

[illegible]

PUEBLO INDIANS OF NEW MEXICO

by David Hare

Distributed by William Salloch,
344 East 17th St., New York, N. Y. [illegible]

DAVID HARE, a well known artist [illegible] photographer of much skill, has prepared a portfolio of his own photographs in natural color. The subjects chosen are Indians of eighteen different pueblos of New Mexico, ranging in age from an infant to a centenarian. No Pueblo Indian is shown in a Plains Indian headdress, nor even in the ceremonial costume of his own people. Each is shown as he is today in the everyday European clothes that he has adopted from the white man. The only things to remind one of the old-time, pre-Spanish costumes are in some cases the headdress and a modest array of beads and other jewelry.

These are photographs of Indians with emphasis on the Indian as a human being. [illegible] well-known kodachrome process, but, as Mr. Hare explains, from direct color sep[illegible] process. They are dye transfers from gelatine matrices, and each print is an original [illegible] The prints are about ten by thirteen inches in size, and are mounted on mats of thirteen and one-half by seventeen and one-half [illegible] this collection of photographs. Very appropriately, it is an adaptation of Indian pottery designs.

These are the best photographs in natural color of people that this reviewer has ever seen. When one looks at the face of one of these Indians, he can hardly keep from exclaiming, "That is not a photo[illegible] skin!" Beads and turquoises are unbelievably realistic! And the collection is made much more interesting and valuable by an analytical Intro[illegible] Dr. Clark Wissler, [illegible] Anthropology [illegible] the American Museum. The Library of the American Museum is fortunate in having a set of these superb and unique pictures.

[illegible]

SIERRA OUTPOST

by Lula Lofberg and
David Malcolmson

Duell, Sloan & Pearce, $2.[illegible]

A FEW people, but very few, can record observations concerning wild animals they have known intimately without becoming maudlin or anthropomorphic. Mrs. Lofberg manages to avoid such foolishness with a fair amount of success, and while she had pet names for each animal, she points out that this was out of respect for the personality of each creature that she came to know in her secluded mountain home.

Her book is a delightful, factual account of events that took place in the Sierras of Fresno County, California. Mrs. Lofberg spent nine interesting years at Florence Lake, 7,300 feet above sea level, where her husband was an engineer engaged on a hydroelectric project. Armed with a copy of Chapman's bird guide and an intelligent interest in the reptiles, birds, and mammals, the Lofbergs established the highest year-round birdbanding station in the Biological Survey, enticed numerous mammals into their "yard," and all in all gleaned much from their Sierra sojourn. Woven into the account of their hardships in a camp cut off completely during the winters from the nearest towns are observations on birds, woodchucks, squirrels, chipmunks, white-footed mice, skunks, coyotes, and timber wolves. Accounts of the several coyotes they watched so carefully contain information that trained observers have failed to record, and there are sound observations on the balance of nature that gradually became restored after the construction gang the first year had destroyed the equilibrium locally by killing many of the larger predators.

Despite its factual reporting, *Sierra Outpost* is thoroughly good reading. There is little foundation for a few speculations, such as that concerned with the supposed mating of a coyote and a timber wolf, but Mrs. Lofberg makes no pretense of being a trained observer with a scientific background. Her modesty is in pleasant contrast to the writing in many books on the market that seemingly were written to glorify the author; she has been neither effusively sentimental nor spectacular, and for the most part her interpretations have been accompanied by cautious qualifications. The caliber of the book is greatly improved as a result.

C. M. BOGERT.

WITHIN THE SOUND OF THESE WAVES

- - - by William H. Chickering

Harcourt, Brace, $3.00

IN these days of fast-moving and terrifying world events, an increasing number of authors are turning to write of remote periods of history, or of small or little-known people. By limiting their theme to such small groups as the history of the Hawaiian islands, they are developing a new sort of escape literature, replacing that kind which used to be written around the Noble Savage, the Noble Red Man, and various colored shadows of the South Seas.

Within the Sound of These Waves is a very good example of this new type of writing, combining quite careful research into old historical sources with an exceedingly romantic treatment of the past of Hawaii, as the Hawaiians once described it in their myths. Although the author's purpose is not explicit, the book does actually give, by the ease with which it slips between telling of ancient myth and historical king, a very good impression of the way in which the past and the present, the Gods, their heroic descendants, and those Hawaiian chieftains who encountered the first white voyagers, were probably linked together in the native mind. The details of the visit of Captain Cook and his murder by the natives have been looked up with care, and the scene is related with spirit and a good deal of first-hand comment from the diaries and reminiscences of the members of Captain Cook's company.

So, by giving a gay and rapidly-moving selection from Hawaiian mythical history, followed by an equally gay and somewhat documented account of early historical days in Hawaii, the book manages to give a feel for the islands and their type of sense of the past.

MARGARET MEAD.

ELIAS BOUDINOT, CHEROKEE

- - - - by Ralph Henry Gabriel

University of Oklahoma Press, $2.00

ROMANCE, tragedy, grim realism, and religious intolerance characterize this story of two lives,—the youth, a Cherokee Indian, the girl, a sincerely religious Protestant of Connecticut. The Indian youth is educated and well-conditioned to the white religious culture of the time, to the end that he becomes a religious leader among his own people; the girl is the daughter in an old white family noted for their religious zeal. They fall in love at the beginning of the story. The girl is fanatically religious, feeling a call to go among the Indians as a missionary and the bride of this young Cherokee. The family and the community are horrified, attempt to force the girl to desist, and resort to a mass meeting in which her own brother burns her effigy, with the result that she is more determined than ever to follow the dictates of her heart and the mandates of her religious conviction.

Yet this is not fiction but plain, fully documented history. Elias Boudinot and Harriet Gold are real persons. They begin their mission on the Indian Reservation, become influential, live normal, happy lives, yet are involved in the terrible tragedy of the Cherokee nation,—the wife to die a natural death, the husband to be assassinated as a martyr to his conscience.

The author is a historian of note, able to write history as if it were fiction. Our readers desiring a striking chapter in the social history of New England and the South should consider this volume, for the statements are accurate and the social interpretations justifiable. Further, the book is written in a pleasing artistic style.

CLARK WISSLER.

BY LIGHT OF SUN

- - - - - - - by Elsie Symington

Putnam,. $2.00

THIS is not a how- or what-to-do book on gardening, though there is no doubt that the author is well-versed in the art. Rather, it is a treatise on the richer and more abundant life that is attained through intimate association with mother earth. Here is the inquisitive mind of the true lover of nature, always seeking for whatever revelations the Creator of all growing things is willing to impart. The autobiography is richly informative, noble in conception, and very absorbing. Not only is it well worth reading, but also rereading, for it passes on to the reader a philosophy of life and the serenity of spirit which reward those who live close to the soil.

There are a few illustrations, to be exact three in number, done in woodcut. They are very good in draftsmanship and composition, and are in keeping with the spirit of the narrative, adding much to its attractiveness. Would that there were more of them, for the book is worth it.

LAURENCE BLAIR.

BIRDS IN YOUR BACKYARD

- - - - - - by Virginia S. Eifert

Illinois State Museum, Paper-bound, 60¢

THIS book has the tang of originality. The page biographies contain the local and general information one expects to find in a work of this scope, but there are also descriptions of appearance, voice, and characteristic traits, presented with a freshness of expression evidently born of intimate acquaintance with the living bird.

The author's brush rivals her pen. Her 95 full-page drawings are lacking in detail, but, in some exceptions, they are animated by that essence of individuality that makes a successful portrait. For good

Continued on page 252

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Curator of Insects

American Museum of Natural History

● Just for the fun of it some years ago Dr. Lutz started casually to collect and record the number of insects to be found in his home lot, 75 by 200 ft. One of the results was that fascinating exhibit at the Museum, "Insects of a Suburban Yard." This book is the other result. The record of the years of adventure that the author experienced in that small space as he found no less than 1402 species of 26 different orders. With humor and imagination Dr. Lutz tells of his experiences with his "Guests." Illustrated with 53 halftones and 40 line drawings. $3.00

G.P. PUTNAM'S SONS, New York

Natural History

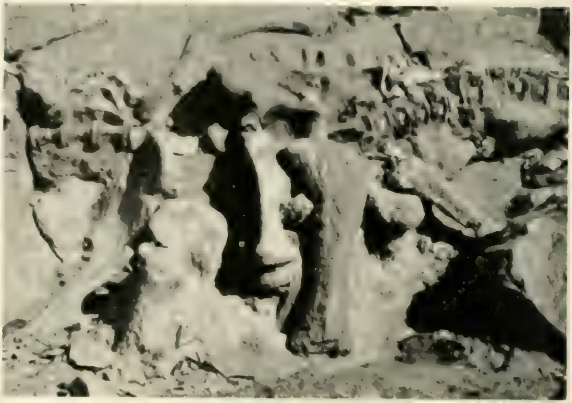
ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

[illegible]

HUNTING DINOS WITH THE CAMERA



Photograph of a large dinosaur where it fell

By CHARLES H. COLES

[illegible]

STRADDLING the border between Utah and Colorado lies Dinosaur National Monument. A sharp upthrust of Jurassic-Triassic sandstone has laid bare the bony remains of ancient beasts in this desolate region. To protect these valuable deposits from the marauding hands of souvenir-hunters, the United States Government has drawn this area into its protective custody so that only duly accredited scientific organizations may remove specimens. The rangers on guard are only too happy, however, to show visitors the petrified remnants of these ancient inhabitants of our country. A small museum at the rangers' headquarters displays a large number of odd bones left by several scientific expeditions.

Dinosaurs in the rock

Photographing the partly exposed specimens in the rock is by no means easy. When an expedition is at work, there may be sections of a skeleton sufficiently well excavated to enable the interested spectator to see a considerable portion of the bony structure of one animal. Generally a paleontologist will work in and around bones that bid fair to yield a more or less complete skeleton intact, even though buried entirely in the rock. If the skeleton lies with its length parallel to the surface of the rock, the chances are pretty good that at some stage in the excavating a well-defined outline of the dinosaur may be seen and pictured. Do not assume, however, that a whole dinosaur or even a major part of one, may be seen at the Monument at the present time. No expedition is working there now, and consequently only small fragments are visible.

Taking pictures of these fragments presents many difficulties because of the similarity in texture and color of the bones and the surrounding rock. Only because the bones protrude slightly above the rock surfaces and so form shadows when the sun falls upon them is it possible to photograph the specimens. Outlining the bones with chalk to make their edges more apparent will help greatly. Our two eyes can detect these weathered-out bones because of their ability to "read in" the illusion of depth, but a photograph does not show this third dimension. The use of shadows, chalk, and perhaps a pointing finger included in the picture, will locate and outline the fossil remains.

Photographs in color do not reveal the bones any better, since they are almost the same color as the rock.

Fossils in the Bad Lands

The Bad Lands of South Dakota contain a large number of fossil deposits of the Tertiary period, which came just after the decline of the dinosaurs. This year the American Museum of Natural History sent an expedition under the leadership of the late Dr. Walter Granger to collect specimens of fossil mammals. Kodachrome still photographs as well as motion pictures were made of some of the expedition's activities to be used for educational purposes.

The intense brightness of the Bad Lands is due both to the clear, dry air and to the very light color of the hardened sand. So dazzling is the reflected light that the needle of a photoelectric exposure meter bounces clear off the upper end of the scale. Obviously the meter is of no use under these conditions.

To render the instrument serviceable, a piece of card from a film carton can be fastened to cover half the photoelectric cell window, thus reducing the light intake to half its value. The needle now falls back to a usable section of the scale. The difficulty here is that all readings must be doubled before translating them into terms of diaphragm setting and shutter speed, and, of course, the dial calculator of the meter accommodates no such high light values. The solution is to place a 2x yellow green filter over the camera lens and just forget to compensate for it. The meter is then read as it normally is. The filter compensates for the card on the exposure meter.

Color photography

It is a good rule to make use of the meter readings for exposures on black and white film but to ignore them for Kodachrome exposures. In the filming of the expedition's activities, the photoelectric exposure meter would have had us use a lens aperture of f:22 at 1/25th second for Kodachrome. Actually, the minimum possible exposure for daylight Kodachrome seems to be 1/25th second at f:11. Less than this will result in too dark a transparency. So, screwing up his courage, the photographer set his motion picture lens to f:11 and shot the scenes in color. The films turned out perfectly exposed; and still Kodachrome exposed in the same manner turned out equally good.

Here also the specimens are about the same color as the sand. In one place dozens of shells from fossil turtles are seen. Casts of the bodies of the turtles lie beneath the shells, although no skeletal remains are in evidence. Pictures of the shells present no problem because of their size and clearly defined shapes. Though some shells have weathered into fragments, many of them are still intact. Photographing these from the shadow side emphasizes their outlines. Pictures made with the sun behind the camera show practically no differentiation between the sand background and the light-colored shell.

Because the excavated skulls of some of the larger four-footed animals are rather delicate, they have to be held together for shipment by shellacking to them pieces of thin rice paper. In order to obtain surface details, the pictures were made before this operation was begun, for the rice paper covers and obscures all faint contours. Taking advantage of glancing sunlight, the photographer was able to bring out hardly noticeable undulations by slightly exaggerating them. It is preferable in all photography of this type to set the specimen upon a background differing in color sufficiently to produce contrast. Just wetting the sand around the specimen will darken the background enough to produce the desired effect. In this way the outlines of the object are well defined.

The stay-at-home photographer who is lucky enough to find fossil remains not too far from his own doorstep and the traveling filmer who is privileged to visit our country's great storehouses of prehistoric bones will both find in fossil filming a challenge to their ingenuity and photographic skill.

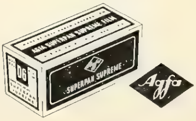
Hard going but—

IT'S easier to climb a mountain, if you've the proper equipment. And the same holds true when you're taking pictures. Be sure you have the *one* film guaranteed "Pictures that satisfy or a new roll free!" Agfa!

For all-purpose use . . . buy Agfa Superpan Supreme. It's ideal for day or night use, indoors or out. Its combination of high-speed, fine grain and full color sensitivity makes it the first choice of many naturalist-photographers.

Your dealer has Agfa Film in a size to fit your camera. See him soon! **Agfa Ansco, Binghamton, New York.**

Agfa Ansco Film



MADE IN U.S.A.

[illegible]

[illegible]

F. M. [illegible]

WE FOLLOW THE WESTERN TRAIL

by [illegible] Ruth Wheeler

Macmillan, [illegible]

WANDERLUST [illegible] while many will respond to the lure of the promise of solitude. From Mrs. Wheeler's book *We Follow the Western Trail* the indication would seem to be that the whirr of bird wings, or the possibility of [illegible] bird activities, was the magnet that drew her into the open. The theme, which at [illegible] about her experiences having to do with birds of the West coast.

Probably the ornithologist will find her recordings of the nesting habits of rosy [illegible] her most dramatic description will be found in the chapter pertaining to the immense havoc [illegible]

Naturalists who have been intrigued by California's ever-changing contours and diverse forms of life, will find that Mrs. Wheeler strikes many a responsive chord in this account of her answer to the wan[illegible]

[illegible]

FOUNDATIONS OF BIOLOGY (Sixth Edition)

by Lorande Loss Woodruff

Macmillan, $3.75

MANUAL OF BIOLOGY (Sixth Edition)

by George Alfred Baitsell

Macmillan, $2.75

DOCTORS WOODRUFF and BAITSELL of the Osborn Zoological Laboratory at Yale have reissued these estimable works in new editions, which bring the respective texts up to date in every respect. In these supplementary volumes, the student will find thorough grounding in the science of living matter, presented in a manner that is a signal credit to both publisher and scholar.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

[illegible]

1. [illegible]

2. Amber is
   (a) [illegible]
   (b) [illegible]
   (c) [illegible]

3. Kohl is
   (a) [illegible]
   (b) [illegible]
   (c) [illegible]

4. The early fishes that gave rise to all the land animals developed legs so they could
   (a) [illegible]
   (b) [illegible]
   (c) [illegible]

5. The body cells of a mouse are [illegible] the same size as those of an elephant.
   True ...... False ......

6. [illegible] because
   (a) From birth to death they lose none of their original bodily fluids
   (b) They manufacture water from their dry food
   (c) They absorb rain through their [illegible]

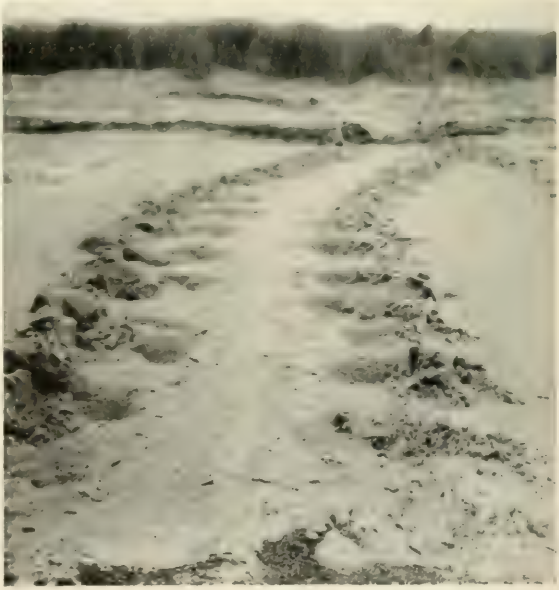
7. [illegible] both on land and in the water, the amphibian is Nature's [illegible]
   True ...... False ......

8. Does the yolk of a hen's egg eventually develop into the chicken's body, while the white becomes the feathers?

9. The largest [illegible] in the world weighs
   (a) one-quarter ounce
   (b) one-quarter pound
   (c) one-quarter ton

10. If you saw the tracks shown in the photograph below, what animal would you say had passed?

WHAT PASSED BY? An unusual photograph submitted by John M. Lofton, Jr., of McClellanville, S. C. If the picture itself does not tell you, see Answer to Question 10, on page 256



NATURAL HISTORY TRAVEL GUIDE

THE SOUTHWEST

Guaymas

Guaymas is situated opposite Lower California in the northwest sector of the Mexican mainland, and is one of the principal resort towns on the Gulf of California coast. Both commercial and game fish exist in abundance in this region. Other recreational facilities are outlined in the advertisement below.

Arizona

Among the sights of interest to NATURAL HISTORY readers touring this locality are the large Papago Indian Reservation just southwest of Tucson, and the San Xavier Reservation immediately to the south. National Monuments and government-protected forest lands stud the entire state of Arizona, of which the northeastern corner is given over to the Grand Canyon National Park. Subscribers may gain some idea of the breath-taking grandeur of the southwestern desert scenery by referring to Josef Muench's magnificent "Skyscrapers of the Desert," a photographic story of Monument Valley, which appeared in last month's NATURAL HISTORY. The hobbyist interested in places of archaeological or fossil-hunting significance will find hereabouts an embarrassment of riches, rivaled only by the extent and variety of the natural wonders in which this section abounds. Arizona is full of historical interest, from its southwest corner where the Devil's Highroad (soon to be described in NATURAL HISTORY) still lives up to its record as one of the most dangerous thoroughfares ever traveled by man, to the Hopi and Navaho country in the northeast.

California

Southern California possesses less spectacular canyons than Arizona, but for devotees of natural history the Salton Sea Migratory Bird Refuge, numerous small Indian Reservations, and the Joshua Tree National Monument all deserve prominence on a list of things to see in the Southwest. In NATURAL HISTORY'S selection of rare trees, California had a greater variety of them than any other state in the Union, nor is there any other spot in our country that can equal the range of altitude between Mount Whitney and Death Valley. The latter, contrary to its forbidding reputation, is a winter playground of the first rank. East of San Francisco is the world-famous Yosemite Valley, while to the north lies the Sacramento Migratory Waterfowl Refuge.

LAUGH AT WINTER IN THE
KINGDOM OF THE SUN
SOUTHERN ARIZONA-CALIFORNIA

Pleasure reigns supreme in this gay country. Enjoy your favorite sport, relax and play in the sun. Visit Carlsbad Caverns en route. Fine hotels, inns and guest ranches.

GO ROCK ISLAND

Three fine trains offer unexcelled service. The streamlined, all-Pullman, extra fare **ARIZONA LIMITED** between Chicago and Tucson-Phoenix, leaves every second day beginning Dec. 15 . . . *De luxe* GOLDEN STATE LIMITED and *economy-luxury* CALIFORNIAN—daily between Chicago and Los Angeles via El Paso, Tucson, Phoenix and Palm Springs . . . Through service daily from St. Louis and Memphis. Connecting service from Twin Cities via Kansas City.

For information, write
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Rock Island Lines
723 La Salle St. Station
Chicago, Illinois

Rock Island

THE DIRECT LOW ALTITUDE WAY

Want a new place to go this winter?

Try Southern Arizona, or Hotel Playa de Cortés at Guaymas, Mexico

Wouldn't you like to get away for awhile to a place where the winter sun is warm and the troubles of the world seem very far away? Here are two suggestions:

1. Southern Arizona's luxurious resorts and real western guest ranches invite you to enjoy summer sports all winter in the enchanting setting of the Arizona desert.

2. Southern Pacific's Hotel Playa de Cortés at Guaymas, Mexico, offers you modern American comfort in the friendly, foreign atmosphere of Old Mexico. Famed as "The Desert Resort by the Sea" (see illustration at right), Hotel Playa de Cortés opens December 1. Riding, swimming, tennis, fine deep-sea fishing.

Streamlined "Arizona Limited"

Starting December 15, the streamlined *Arizona Limited* will run every other day from Chicago to Tucson and Phoenix in the Southern Arizona resort and guest ranch country. From Tucson, a Pullman takes you to Guaymas. There's fine daily service to Tucson on Southern Pacific's *Golden State Limited* and *Californian* (Chicago-Los Angeles), *Sunset Limited* and *Argonaut* (New Orleans-Los Angeles).

S·P

The Friendly Southern Pacific

Mail This Coupon

O. P. Bartlett, Dept. NH-11, 310 So. Michigan Avenue, Chicago, Illinois.
Please send me folders describing Arizona and Hotel Playa de Cortés.

My Name ________________
Address ________________
City __________ *State* ______

Sirs:

[illegible]

Sirs:

[illegible] ing charts: "Cycle of Life," "S.O.S. for [illegible] Houses," for which I enclose 20¢

[illegible]

[illegible]

Forest Park, Ill.

Sirs:

[illegible] Natural History [illegible] which accompanied the article on termite architecture by Dr. Alfred E. Emerson in [illegible] it might be pointed out that Panama possesses some of the finest termitaria in the world.

The smaller termite "houses" are apt to be hemispherical, resembling somewhat an overturned round-bottomed kettle. But they may form about and conform to the shape of any core structure, such as a crooked fence post; and as they grow larger, may become more acutely conical, like a huge inverted funnel.

Some of them with rather flaring bases measure more than 30 feet in circumference. The taller ones are as high as the combined height of two average men.

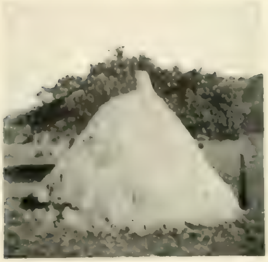
The inside of one of these "air-conditioned" mounds is a disappointment to the amateur, who has labored hard to cut into it. All that he sees is a cross section of many tortuous and ramifying galleries of small bore. Usually there has been an exodus of the occupants at the approach of the hacking tool, and the few soldier termites that form the rear guard are scant reward. But the expert termitologists may find the galleries of great interest. Examining these mounds of *Amitermes* [illegible] on May 11, 1935, Doctor Emerson found more than a dozen other kinds of termites living in their runways, some of them new species!

The national highway enables one to get a creditable view of the termitaria without getting out of the car. In the dry season when the growth is not high, one can see small to medium-sized mounds from near Panama City all the way to Aguadulce (about 130 miles). Here they reach their greatest development within about two miles of the city. Closer inspec- [illegible]

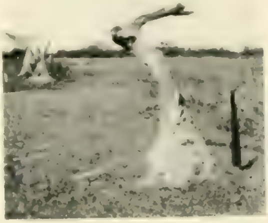
George O. Le

Canal Zone Junior College,
Balboa, C. Z.

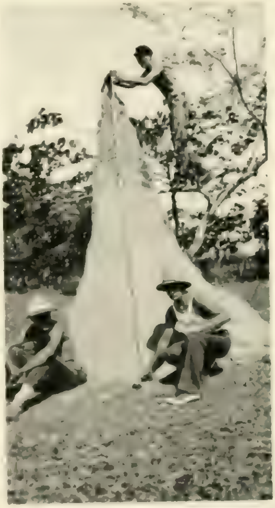
1 The smaller termite mounds of Panama are apt to [illegible]



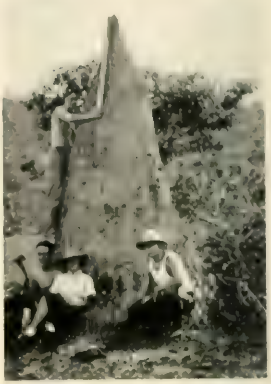
2 . . . but they may form about any core structure such as a crooked fence post and take their shape from it.



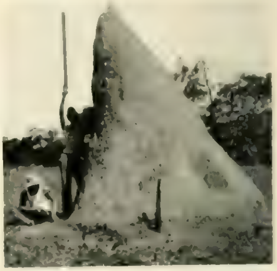
3 As they grow larger, they become more acutely conical



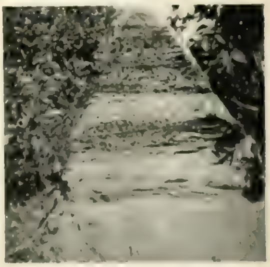
4 In height they range to eight and ten feet or more. Carefully measured in connection with the Canal Zone Junior College field biology class, the flaring bases of the largest ones proved to be more than 30 feet in circumference



5 Many of the termite "houses" slope off center. Evidence of compass orientation was at first suspected but this is not the case. Possibly local factors such as the direction of the wet season rains determine the direction of the building.



6 A cross section of one of the mounds reveals many tortuous and ramifying galleries, from which most of the occupants have departed except for a few soldier termites that form the rear guard



DO NOT MISS

From the whole broad realm of Natural Wonders

BIG

- THE FAMILY TREE OF THE DINOSAURS—a special feature of next month's NATURAL HISTORY Magazine, showing for the first time in one pictorial display all the main types of dinosaurs and their family history down to their extinction 60 million years ago.

LITTLE

- A HOUSE OF BUBBLES—a brilliant series of close-up photographs revealing pictorially for the first time in history how the tiny froghopper builds its almost microscopic home.

HOT

- THE DEVIL'S HIGHWAY—the epic story behind a road in the United States on which more than 400 persons have perished from heat and thirst, the last of them within the past few months.

COLD

- WE LIVE IN AN ICE AGE—proving that we have not emerged from the last glacial period and that it is an even guess whether palm trees may grow in Alaska or continental glaciers once again descend, to bury our civilization a mile deep in moving ice.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Fall and Winter, 1941-'42.

SUNDAYS over the Mutual Broadcasting System from 9:30 to 10:00 A. M.

This Wonderful World. Questions and answers on nature subjects, and discussion of Museum exhibits brought before the microphone.

•

SUNDAYS over the Columbia Broadcasting System Network from 1:30 to 2:00 P. M.

This Is the Life. Discussion of the life history of Man in various lands, based on exhibits in the anthropology halls of the American Museum.

•

WEDNESDAYS over the Columbia Broadcasting System Network from 9:15 to 9:45 A. M. (Central Time: 2:30 to 2:55 P. M.; Mountain Time: 9:30 to 10:00 A. M.; Pacific Time: 1:30 to 2:00 P. M.)

Lands of New World Neighbors. The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

•

FRIDAYS over the Columbia Broadcasting System Network from 3:45 to 3:55 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.

No two ways about it....
...once you've tasted Teacher's Scotch, you'll remember the name for a convincing reason . . .
"It's the flavour"
TEACHER'S HIGHLAND CREAM
Perfection of Blended Scotch Whisky
86 PROOF
Made since 1830 by Wm. Teacher & Sons, Ltd., Glasgow
TEACHER'S
Perfection of Blended SCOTCH WHISKY
SOLE U. S. AGENTS: Schieffelin & Co., NEW YORK CITY · IMPORTERS SINCE 1794

[illegible] often ignored entirely. Yet all the elephants that have ever lived in the [illegible] in a single epidemic.

[illegible] because of our intimate knowledge of [illegible] Niagara and the Grand Canyon seem huge to us. Yet the telescope reveals among the stars wonders of such magnitude that, in comparison, our earth dwindles to an insignificant speck and the human beings upon it shrink to the dimensions of microscopic germs.

"Therefore, size is relatively unimportant. The most significant factor is life, which is of the same nature in microscopic organisms as in ourselves."

Honors

Doctor Miner's expeditions have taken him from New Brunswick to the West Indies where he joined other Museum colleagues in the historic effort, sponsored jointly by the American Museum and the New York Academy of Sciences, to carry out a concentrated biological survey of Porto Rico and the Virgin Islands, while other expeditions took him [illegible] the Lesser Antilles [illegible] material for the Pearl Divers Group.

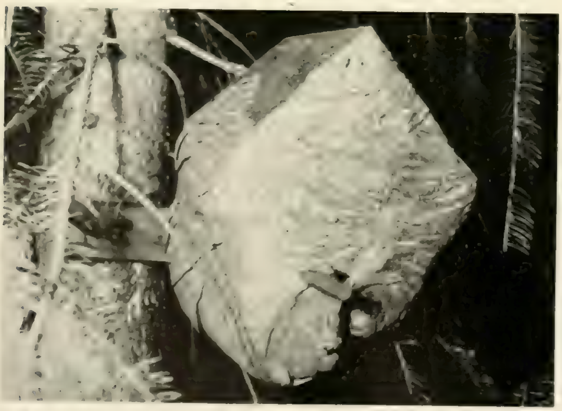
Always popular with his colleagues and associates, Doctor Miner is ever in the vanguard of general activities. In fact, the Curator of Living Invertebrates never lets the dignity of his position interfere with his good fellowship at Museum social affairs. And he inevitably figures prominently on committees. He is Chairman of the Committee on the Popular Publications of the Institution and has represented the Museum at several scientific gatherings in other cities.

For many years he has served the New York Academy of Sciences in various capacities and is now winding up his second term as President. "There won't be any third term," he says with a twinkle. "The constitution doesn't allow it." Many additional honors have deservedly been bestowed upon him including an honorary Doctorate of Science from his old Alma Mater, Williams.

Since he is already at work on the part played by the continental shelf in the life of marine animals, we may expect new projects of public education to be forthcoming from his expeditionary activities, which will undoubtedly be as brilliantly conceived and supervised as those already standing as monuments to his name.

BLITZED BIRDHOUSE

PRIORITY meant nothing when a swarm of social wasps decided to take over this wren house on the campus of Keuka College, Keuka Park, New York. Nor did they spare the photographer, R. F. Hart, who was given a warm reception when he took this unusual picture



BOOK FAIR

at the American Museum of Natural History

•

Nov. 26, 27, 28, 29
10:00 A.M. to 10:00 P.M.
Nov. 30 1:00 P.M. to 5:00 P.M.

•

The Natural Sciences
in literature past and present

Special Features
well-known speakers at afternoon
and evening sessions

FLOWER SHOW

The Flower Show of the New York Horticultural Society will be held this year from November eighth to tenth at the American Museum of Natural History. Members of the Museum are cordially invited to attend this exceptional exhibit.

NOTICE

Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

Answers to Questions on page 252

[illegible]

December **NATURAL HISTORY** 1941

Family Tree of the Dinosaurs · We Live in an Ice Age

South Sea Life · Capturing Sharks Asleep · Wasps

VOLUME XLVIII. No. 5 FIFTY CENTS

"Gentlemen, this is our best Annual Report in years . . . and the best in looks, ever!"

Your Annual Corporation Report need not be limited to a cold, dollars-and-cents statement of assets and liabilities . . . deferred charges and depreciation . . . interest and income.

Few stockholders understand these things. As part owners of your company, they want to know more about the products you make . . . your plants and processes . . . markets and management. Keep them sold on these vital facts and you keep them longer as stockholders!

For many years we have produced Annual Reports for such concerns as American Car and Foundry Company, American Radiator and Standard Sanitary Corporation, American Sugar Refining Company, Starrett Corporation, Federation Bank and Trust Company, and others. Handsome, attractively illustrated brochures, showing the Consolidated Balance Sheet, to be sure . . . but designed to improve public relations . . . to tell the human side of these industries, as well.

With 1941 drawing to a close, now is the time to give thought to this important subject. A Charles Francis representative will be glad to call and make helpful suggestions regarding your next Annual Report . . . whenever you wish.

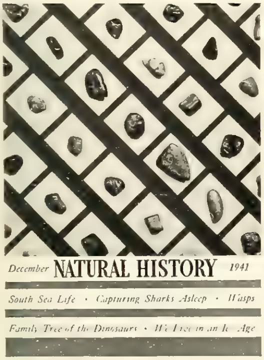
FEDERATION
BANK & TRUST COMPANY

CHARLES FRANCIS PRESS, INC.
461 EIGHTH AVENUE, AT 34TH STREET, NEW YORK

THE COVER THIS MONTH

Were they polished by man, by the elements, or by dinosaurs?

The singular thing about the beautiful stones on the cover of this issue is that they were apparently polished while inside of dinosaurs. Dinosaurs have been accorded much popular attention but their use of these stones is a phase of their life that has been given little public notice. These specimens are from an extensive collection belonging to Betty Beck Roberson of Worland, Wyoming, who has collected dinosaur gizzard stones for several years. The Kodachrome photograph for the cover was taken by Stan Kershaw of Cody, Wyoming, and is probably the first photograph of these remarkable objects—certainly the first in color—ever presented to the public.


December NATURAL HISTORY 1941
South Sea Life • Capturing Sharks Asleep • Wasps
Family Tree of the Dinosaurs • We Live in an Ice Age

As many as 112 of these gizzard stones were found actually within the body cavity of one dinosaur discovered by the American Museum in Mongolia. Quantities of others frequently lie scattered in the rock beds where dinosaur bones are common. Their abundance indicates that certain of the dinosaurs swallowed the stones in considerable quantity to aid in the digestion of their food, particularly the dinosaurs lacking effective teeth. The churning action of the swallowed stones helped to grind up the plant food upon which these dinosaurs lived, just as stones similarly swallowed by chickens today assist in their digestive problem. Dinosaur stones are discussed more fully by the celebrated dinosaur-hunter, Barnum Brown, on page 294 of this issue.

The collecting of dinosaur "jewels" has been popular in certain sections of the West since scientific expeditions familiarized local residents with their existence. But in order to achieve a fine collection, one must walk or drive many miles over badland outcrops during certain favorable seasons of the year, and must hunt through hundreds of quite ordinary gastroliths scattered over the gullies in order to find a few which are perfect and beautiful.

LETTERS

SIRS:

. . . The covers of NATURAL HISTORY are a sort of appetizer for what is to follow. And let me say here that I've never been disappointed in the meal that follows the appetizer. I read it from cover to cover.

MARY M. PERKINSON.

Pawnee, Okla.

* * *

SIRS:

. . . Your magazine is the best of its kind. I enjoy reading it to the last page because of its interesting and informative contents. As long as I am able I shall subscribe to it.

DAVID STEFANYE.

Bronx, N. Y.

* * *

SIRS:

For five years I have been a subscriber to NATURAL HISTORY, and ever since reading the first issue I received, describing the African Hall in the American Museum, it has been my ambition to see it. Last month my wife and I realized that ambition. We spent the whole day, from the time the Museum opened until the guards swept us out, seeing the place. We were so busy we didn't even have time to look for the Member's Room to take a rest. Needless to say, it came up to all expectations; never was a day so well spent. You certainly have a wonderful place, of which you can be justly proud.

I have thoroughly enjoyed nearly all the issues of the Magazine. Of course I am disappointed once in a while, but I realize that what doesn't interest me interests others, and these disappointments are few and far between. I especially wish to compliment you on the beautiful covers you have been having lately. I say this as one whose hobby is photography and who would almost rather take pictures than eat. Also, I especially enjoyed in the October number the article and pictures of Monument Valley. The more such, the finer.

ERNEST B. RIECK.

Albany, N. Y.

* * *

SIRS:

. . . I am enjoying NATURAL HISTORY immensely. The articles are fascinating and the photographs superb. My hobby is birds, and with your publication and the Audubon magazine, my interest has never a dull moment.

RUTH H. RUSCH.

Peekskill, N. Y.

* * *

SIRS:

Once more I am writing to order some of your lovely covers. The calendars I made of them last year were so warmly received that I plan to make more for this Christmas. . . . Your magazine is a cheerful spot in a sad world. Keep up the good work!

THELMA BRACKETT.

Concord, N. H.

Continued on page 304

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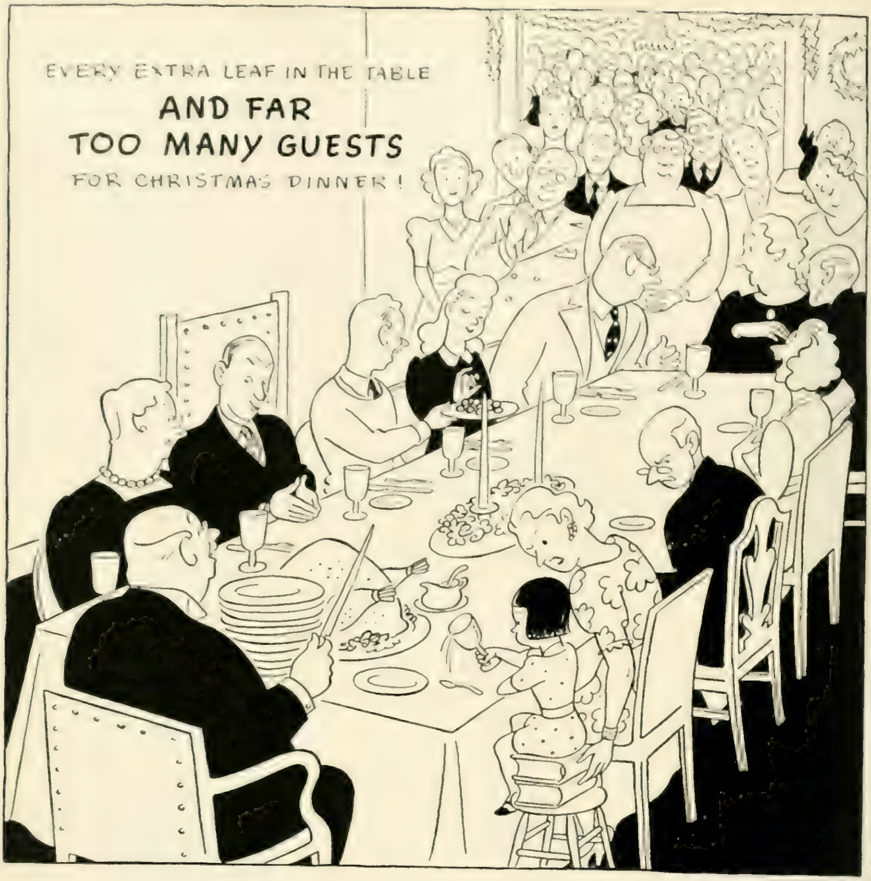
EVERY EXTRA LEAF IN THE TABLE
AND FAR TOO MANY GUESTS
FOR CHRISTMAS DINNER!

That's the situation your telephone company faces every Christmas. That's why there may be delays on some Long Distance Christmas calls.

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We expect the biggest rush of calls we've ever had this coming Christmas. We'll do our best to prepare for it. But some calls will be slow. Some may not be completed. For these, we ask your patience and understanding. . . . *Thank you, and Merry Christmas!*

BELL TELEPHONE SYSTEM

NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Roy Chapman Andrews, Sc.D., Director

VOLUME XLVIII—No. 5 ★ ★ ★ ★ ★ ★ **DECEMBER, 1941**

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SAMOA

By TRUMAN BAILEY

From Three Lions

Eons ago in what is now poetically called the South Seas, a group of volcanoes erupted from the floor of the deep and formed the archipelago of Samoa. For centuries lava poured down the sides of these mountains-in-the-sea, depositing a rich igneous soil, from which, encouraged by the moist, even-tempered climate, arose a riotous paradise of verdure.

At some remote time a band of sea-wandering Polynesians discovered these plenteous islands and, augmented by other voyagers from time to time, cultivated thereon a simple but exceptionally happy way of life. Some surviving aspects of this life are recorded on the following pages.

The native inhabitants of these islands are among the finest and purest Polynesians and are noted for their cleanliness, dignity, mental capacity, and physique. They are fortunately on the increase, because laws prohibit foreigners from buying their land.

Thus the Samoans have survived better than many others the age of imperialistic exploration, which disrupted native life in so many parts of the world. Several major powers have had a part in determining the status of Samoa. In 1900 Britain traded off its interests, leaving six of the islands to the United States, eight to Germany. A few days after the declaration of World War I, a New Zealand expeditionary force occupied the German islands, and these are still held by that dominion under a League of Nations mandate. The United States holds the other six islands, where three native Governors under an American Commandant-Governor administer the territory in conjunction with County and City Chiefs.

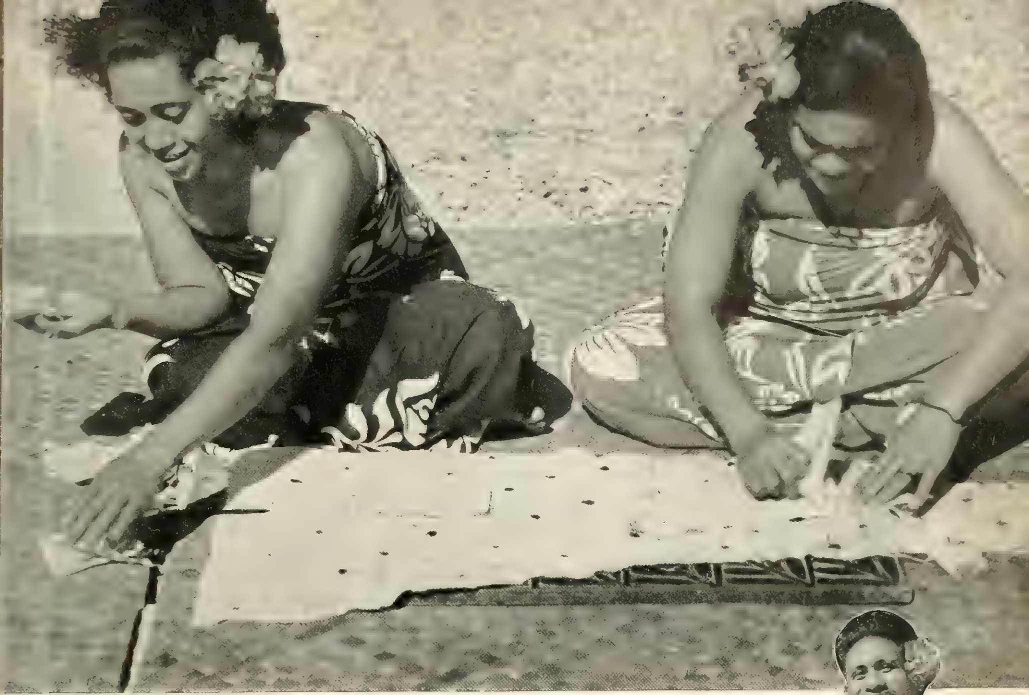
(Left) A SAMOAN BEAUTY wearing tapa cloth, made from the bark of the paper mulberry. Today this costume would be worn only on special occasions. The Samoans are noted for their sea-faring qualities. The small outrigger canoe, or *pao pao,* below, is used in the lagoons and along the reef. Larger canoes and longboats are used for the open sea. In clear weather the mountains are visible from far out to sea, for some rise to over a mile

(Above, left) IN THE MANUFACTURE of tapa cloth, strong native teeth strip the bark from the saplings of the paper mulberry

(Above) AFTER a soaking in sea water, the rough exterior is scraped from the white inner bark

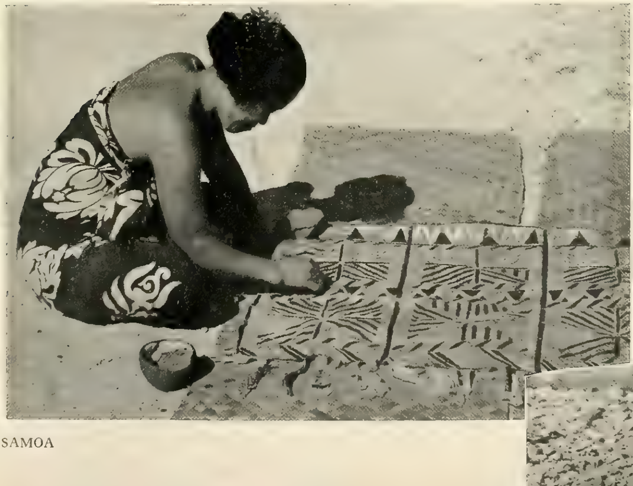
(Left) HEAVY MALLETS of wood are used to beat the remaining bark out into thin sheets

(Below) THESE SHEETS are then appliquéd together with breadfruit paste into an even piece of the desired size

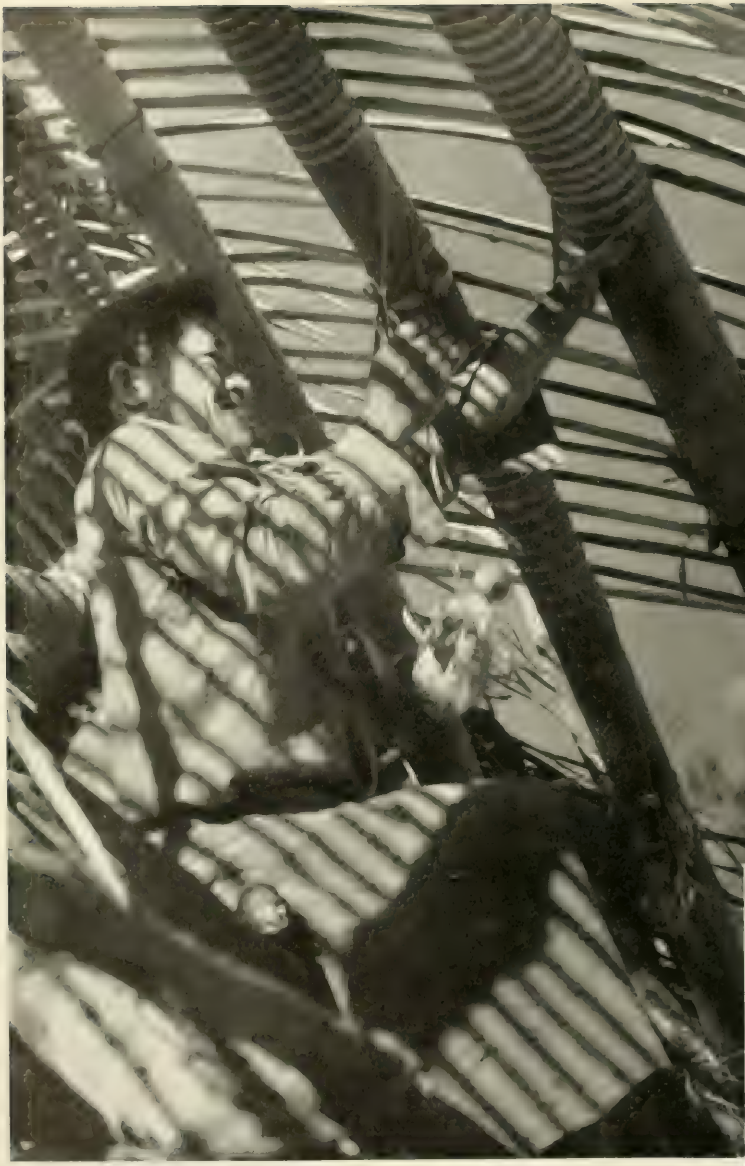


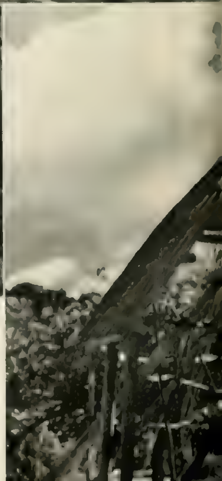
(Above) THE THIN PIECES of beaten bark are placed over a carved board, and the design is rubbed into each layer, —as a rubbing is made of a coin

AFTER THE PATTERN has been transferred, the tapa is finished with additional painting which is applied with a brush. Colors used in this process are made from herbs, berries, and earth



(Right) DEMONSTRATING one use of the tapa, this genial Samoan is properly attired for a ceremonial feast or other important event symbolizing the old life





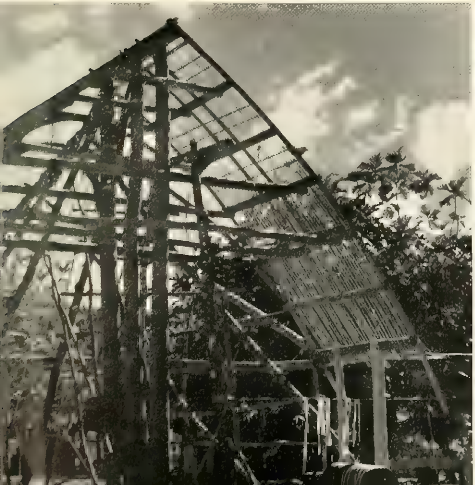
(*Above*) SAMOANS build their houses sturdily without the use of nails. The tough fiber from the husk of the coconut, braided into a cord, is used to lash the framework together. The builder often achieves beautiful designs by the way in which he wraps the cord

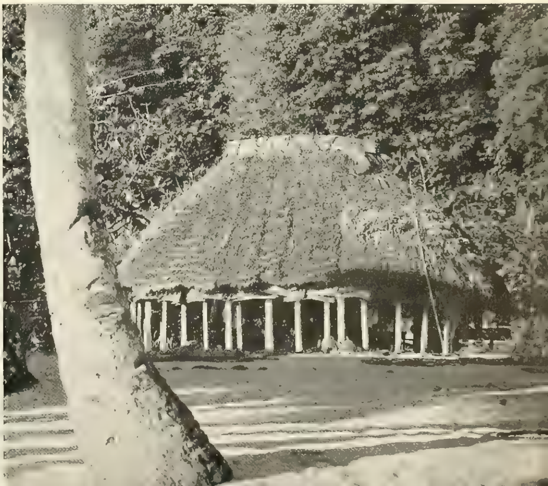
(Right) THE LADY OF THE HOUSE looks her best when she enhances her natural beauty with a floral headdress, a form of adornment in which the lovely girls of Polynesia achieve many ingenious effects.

(Above) STRINGED INSTRUMENTS were introduced to the islands by foreign traders but have come into such general use that they are inseparable from Samoan life

HEAVY STORMS of the hurricane season necessitate a strongly reinforced structure. The Samoan house is usually constructed in sections. The owner may move in when only the central unit and one end have been built, finishing the other at his leisure

FEW HOMES are better suited to their climatic conditions than those of the Samoans. Almost circular in form, they allow free ventilation from all sides. During sudden squalls, which are frequent, mats somewhat similar to Venetian blinds are let down. Here they may be seen drawn up under the eaves. The house is thatched with coconut fronds or sugar cane



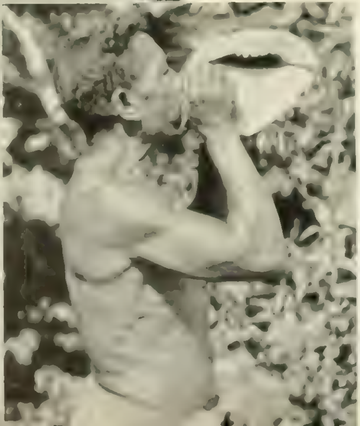


THERE ARE NO WHARVES on many of the Samoan islands, so that one must ride through thundering surf to reach the shore. At left the natives are seen unloading copra on the beach at Luma, on the island of Tau

(Left) COPRA is dried coconut meat, the oil from which is used extensively for soaps and explosives. The coconut palm has been a mainstay of the South Sea Islanders for centuries, and the young Samoan early learns to climb the tree to harvest the green fruit. Coconut meat is the basis of many Samoan recipes. The water inside the coconut provides a delicious beverage, while the husk, beaten into strands and braided, furnishes the cord used in house construction and in many other ways. Aside from what the natives use, American Samoa exports annually about 1100 tons of copra

(Left, below) SHELLS AND DRUMS are used to call the men from the plantations in the hills. A blast from this huge shell can be heard for a mile or more

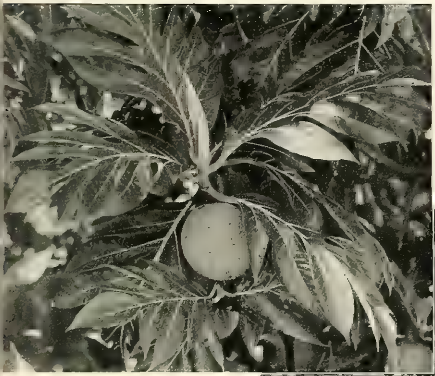
(Below, right) THE MEAT of the coconut is frequently ground up and heated with a hot rock. The warm meat is then squeezed to extract the juice. This juice thickens into a delicious, custard-like substance when cooked with greens, fish, or chicken



(*Right*) TABLE ETIQUETTE in the South Seas does not require silverware or dishes. Fingers replace knife and fork, and a green leaf serves as a plate

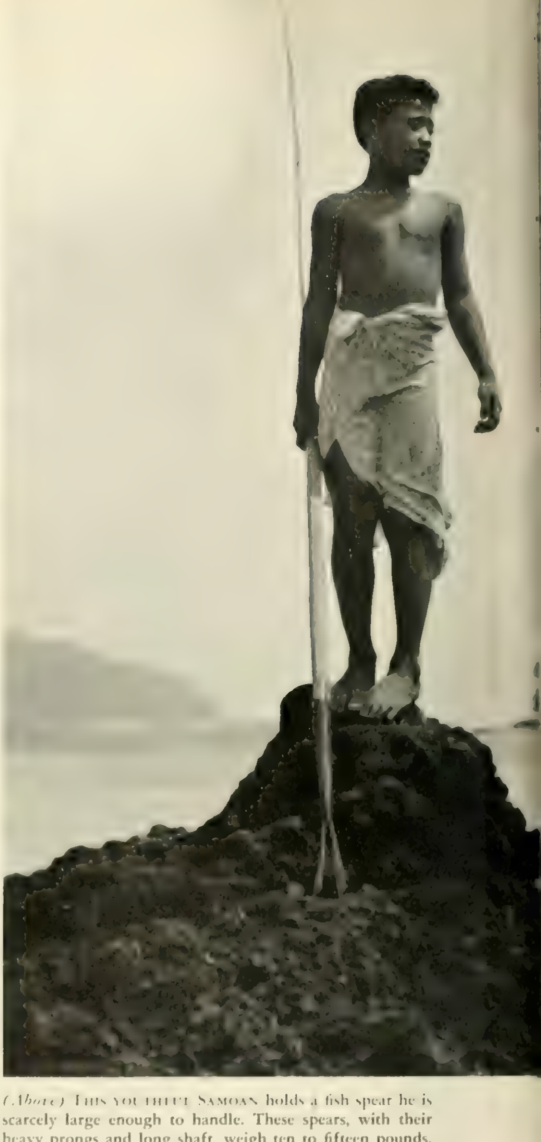
(*Below*) BREADFRUIT is another staple food of the South Seas. So important is this plant to the islanders that the leaf and fruit are favorite motifs in native design

BREADFRUIT is roasted over a fire, much like a chestnut. Before eating, the blackened husk must be removed, as shown at the foot of page. The basket represents another use of the coconut palm



THE PAPAYA, whose juice has become increasingly popular in this country for its flavor and digestive properties, grows abundantly in the Samoan Islands and achieves great size *(above)*

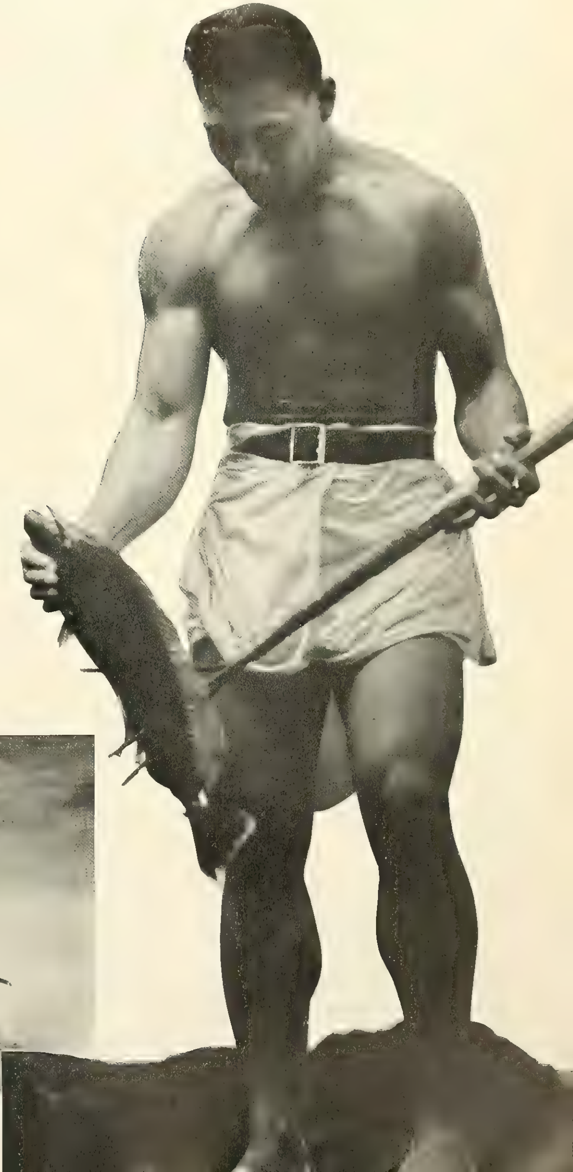
SAMOA'S warm tropical rains are ideal for fern growth. The fronds below were over eight feet long

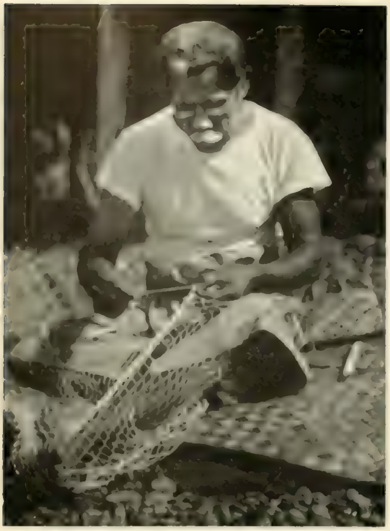


(Above) THIS YOUTHFUL SAMOAN holds a fish spear he is scarcely large enough to handle. These spears, with their heavy prongs and long shaft, weigh ten to fifteen pounds, so that great strength and dexterity are needed to manipulate them while swimming

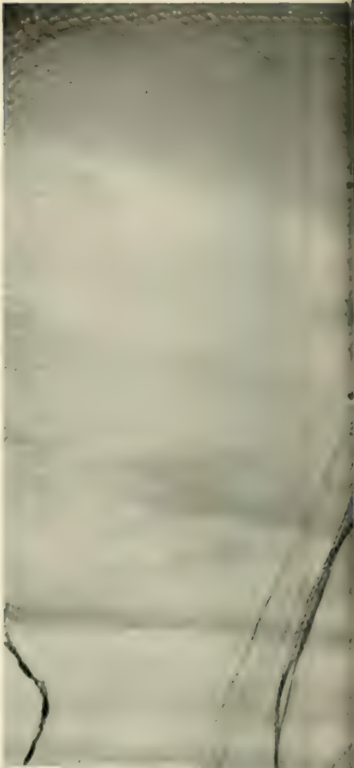
(Right) SCANNING the clear waters from a ledge of rock, the fisherman can spot his quarry many feet underwater. Then he throws the spear with great force and immediately follows it into the water, for he must retrieve the spear to bring his catch safely to shore

Back on the rocks he removes a *poge* from the barbs of his spear, a delicious fish which abounds along the reefs of Samoa



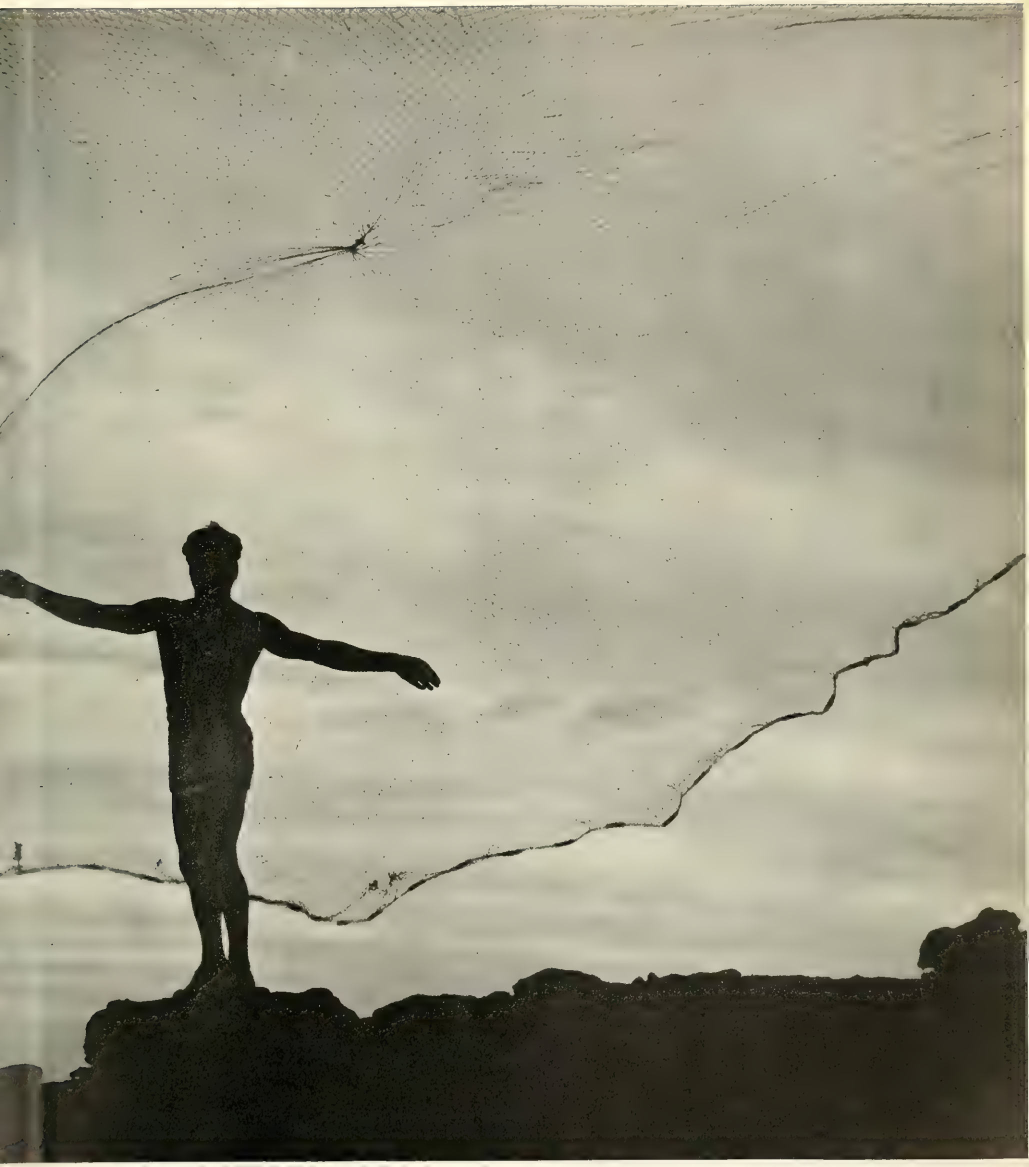


(*Above*) EXPERT HANDS fashion a throw-net, which is used in one of the world's most picturesque methods of fishing. All the knots are tied by hand. Formerly native fibers were used, but today cotton line is procured from the trading stores



WHILE OPERATING THE NET from the coral ledges, great care must be taken in gathering and arranging it, lest it become tangled or torn on the rough rocks

FIFTEEN to 30 feet of circular net is an awkward bundle in the hands of a beginner, yet net-throwing is a popular and practical sport in the islands



THE NET is thrown with a circular motion so that it spreads out like a parachute. The weighted edges sink to the floor of the sea. Then the fisherman must dive into the surf, gather the edges together underwater, and haul his catch ashore. Sometimes a single throw will net as much as 200 pounds of fish

Bring 'em

THE ENRAGED TIGER SHARK lashes the sea to foam as he fights capture with all the fury of his 400 pounds. He is one of the fiercest deepwater fishes but his worries will soon be over, and he will wake up comfortably installed in his new home

(Right) THE WEAPON has guards which prevent too deep penetration or serious injury to the shark. From the tiny holes in the point, jets of anesthetic are discharged into the fish's tissues

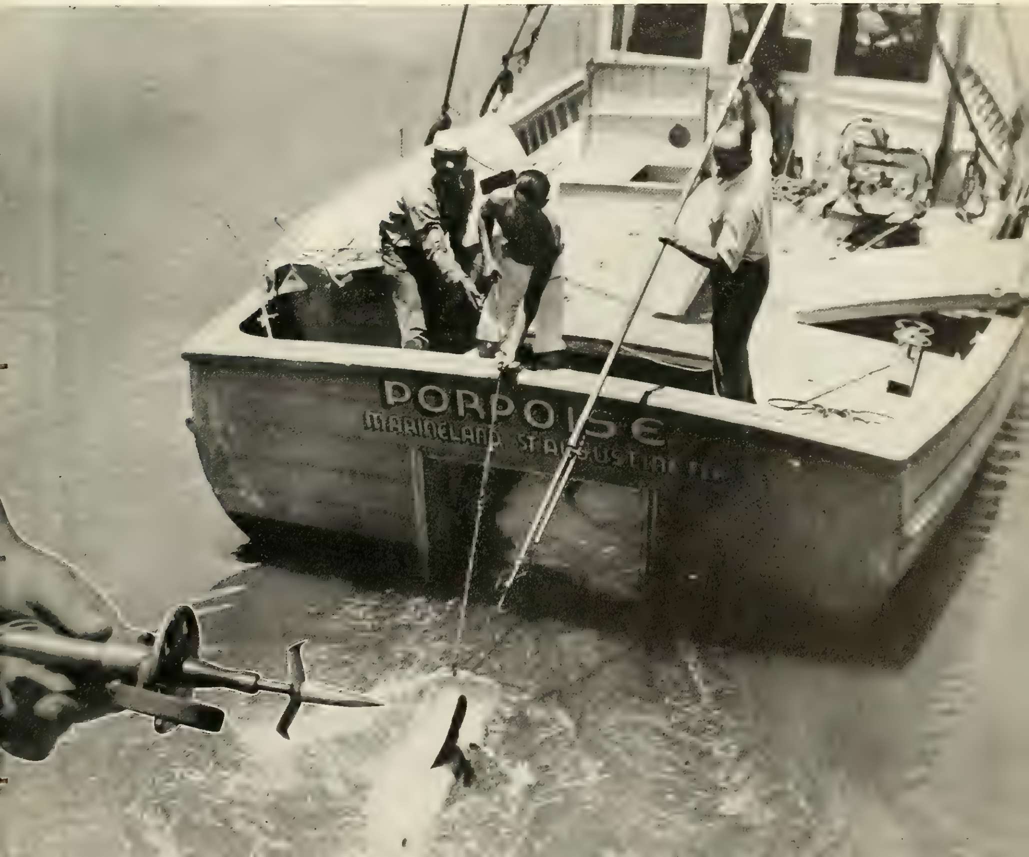
back *ASLEEP*

By ANDRE LA TERZA

Voracious tiger sharks are captured alive for scientific study by means of a new hypodermic harpoon

At the famous Marine Studios in Florida, where visitors from all parts of the world can observe and study the creatures of the deep in glass-windowed tanks, fish experts have encountered difficulty in capturing and transporting big dangerous specimens from the sea. To solve the problem, a new instrument was developed by the late Dr. G. Kingsley Noble of the American Museum of Natural History and Count Ilya Tolstoy, grandson of the novelist. This is a steel-pointed spear which pierces the animal and, with power supplied by ordinary soda siphon gas, anesthetizes it. So effective is the instrument that in 60 seconds a 400-pound monster is rendered unconscious and can be transferred from ocean to oceanarium without injury to himself or to his captors.

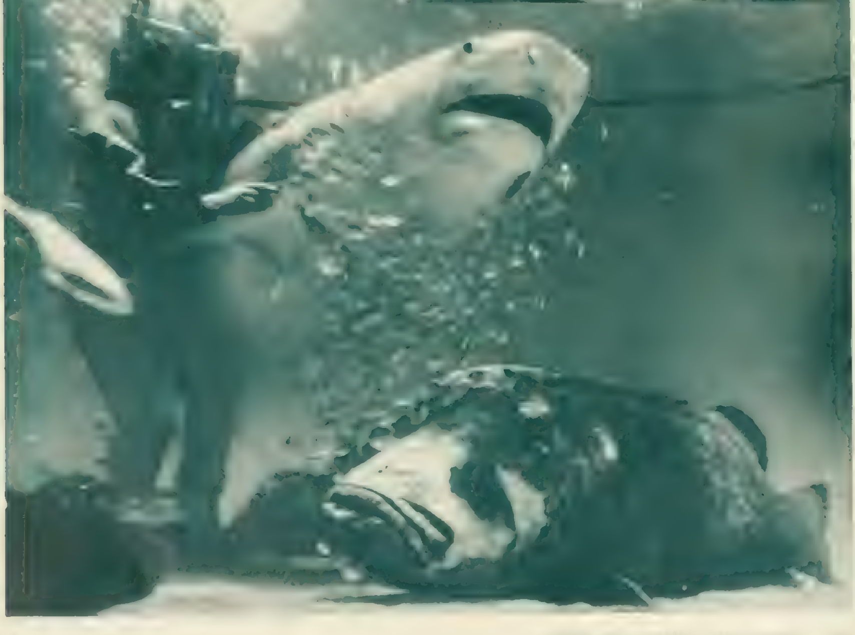
COUNT ILYA TOLSTOY poises the harpoon. A split second later the anesthetizing dart will drive into the tiger shark



(Left) HELPLESS, the huge fish is lowered into a small receiving tank en route to the oceanarium. He has suffered no injury, save possibly a broken tooth or two, which is of no consequence, as he can grow new ones. If he shows signs of waking up, he will receive a second injection

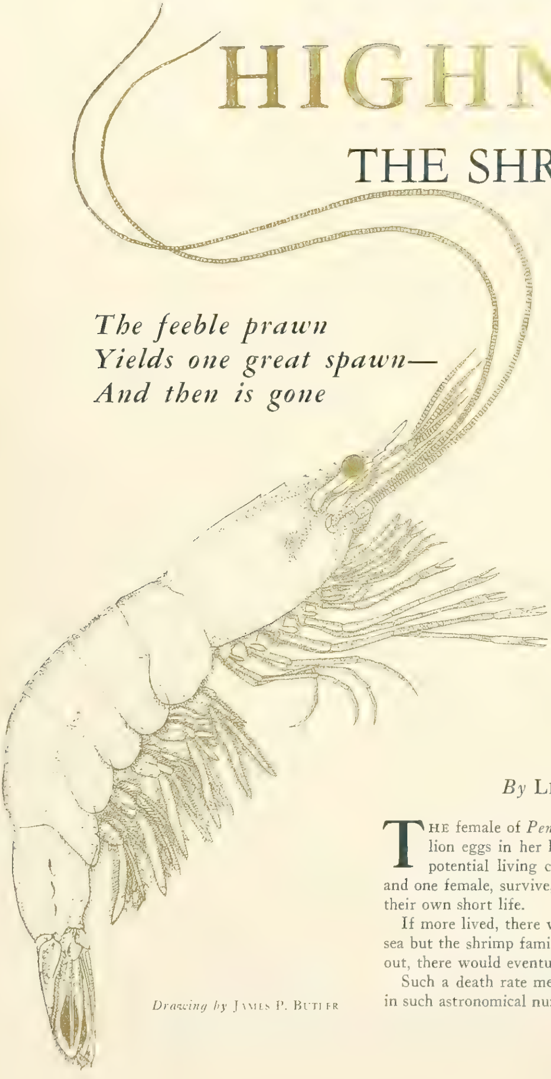
(Right) A WATER-FILLED CANVAS CRADLE hoists the unconscious shark from the boat onto a trailer bound for Marine Studios. He will stay "out" for about three hours

(Below) SAFELY INSTALLED in his new home but still groggy, the shark is nursed back to consciousness by a diver. To keep the fish from drowning, the diver must actually guide him about underwater, forcing water through his gills. When the shark wakes up, the diver makes a quick exit



HIS LOWLY HIGHNESS THE SHRIMP

The feeble prawn
Yields one great spawn—
And then is gone



Drawing by James P. Butler

By Lealen E. Martin, Jr.

The female of *Peneus setiferus* lays half a million eggs in her lifetime. Out of this mass of potential living creatures only two, one male and one female, survive, on the average, to complete their own short life.

If more lived, there would soon be nothing in the sea but the shrimp family; if less than two averaged out, there would eventually be no descendants.

Such a death rate means nothing when they exist in such astronomical numbers. Though only two live [illegible] dollars.

[illegible] little creatures.

Yet history is curiously reticent about the shrimp. [illegible] mon. Aristotle observed and recorded members of the shrimp family. Then, 2100 years later, Linnaeus, the great naturalist, clarified and added to the bit of knowledge. In all the intervening centuries, mention of any crustacean is scant, and of the shrimp it is almost nonexistent.

The very name "shrimp" has always been a synonym for insignificance. But who knows that today the shrimp ranks third largest among U. S. seafoods, exceeded only by salmon and sardines?

For all that, the recorded information is like Mother Hubbard's cupboard. Many of the thousands of varieties of shrimp must have been caught from early times. Despite this, despite its picturesqueness, and despite the fact that—with the possible exception of whaling—shrimping has always been the most widespread fishery in the world, the shrimp is *still* something unknown.

Biologists think that the industry today is near the limit of possible production under present catching and handling conditions and that greater intensity of fishing will not make an appreciable increase in the catch. There are just so many shrimp in the ocean. The catch limit has been approached. When it is touched, more boats will only mean less average catch per boat, unless new shrimping grounds are found. Further, such discoveries are now considered unlikely, for the Fish and Wildlife Service has explored pretty thoroughly along both Gulf and South Atlantic coasts.

How old?

In addition to finding him, there is another problem that Mr. Shrimp poses—the question of his life span. No one has ever seen a shrimp that lived longer than one year, although many a veteran shrimper will tell you: "Man, sure they live for years. Why, way out I seen great big, old fellows, crusted over. Musta' been five, ten, maybe even fifteen years old."

Maybe he did see some aged crustaceans, but they weren't the common commercial variety of shrimp, *Peneus setiferus*, which makes up over 95 per cent of the catch. In contrast to many of his relatives on the roomy crustacean family tree, *Peneus* is a short-lived, tender soul.

For example, he's nothing like the brine shrimp, *Artemia*, which you'll find in the Great Salt Lake region. For *Artemia* represents life in its toughest form and is almost indestructible. Embryos have been subjected to prolonged liquid air baths at —310° F. without harm. They can live without oxygen for at least six months.

Then there are deep sea shrimp that light up; others that climb trees; some that weigh as much as three pounds; and still others so tiny that they can pop up through cracks in the floor. Odd as it seems, this actually happened in suburban New Orleans a few years ago. Housewives, startled at the strange migration, thought the tiny creatures were fleas and vigorously applied insect powder.

This is by way of showing the infinite variety of the shrimp family and not to hint at close kinship with *Peneus*.

The latter, which has many enemies, is extremely sensitive to changes in environment and perishes if they are unfavorable. Starvation gets many of his brothers and, being cannibalistic, he eats some himself.

In delicate balance

The short life span is the bane of the industry, for shrimp are dangerously vulnerable to overfishing. If one year's class of prawn is seriously depleted, Nature's delicate balance is upset. Then it will be nearly impossible for the fishery to return to its former abundance.

Incidentally, shrimping is unenviably unique in this vulnerability, for it is the only major fishery dependent upon creatures which live only one year. In the case of halibut, salmon, oysters, haddock, and other fish, depletion of any one year's offspring is not as vital a handicap to the continuance of the species. All these live several years, and the next season's spawning may take up the slack.

Shrimp, on the contrary, would disappear from the face of the earth if all those born in any twelvemonth were to be annihilated prior to the spawning season. There would be none left to carry on the race. Of course this wouldn't happen, but dangerous reduction of the supply in any given locality is entirely possible.

Biologists know this and admit that there are many unsolved mysteries presented by the fitful fliptails. Part of the trouble is that fewer and less accurate statistics have been available than are needed by researchers. Another part is that in this realm scientists are pioneering. The mass of research into the lives of other creatures of the sea is worth little as a parallel for procedure. Moreover, there is difficulty in studying these crustaceans. Learning their characteristics through raising them in a laboratory is impossible, beyond hatching the eggs and studying embryos.

Their movements

For shrimp, though their name has been a synonym for insignificance, move no insignificant distances during their life. If they are restricted in these movements they die. It's a part of their life urge, brought about by weather changes, water changes, and a host of other things. There's no studying them under ideal conditions. Biologists must go to the sea and learn there what they can.

The common shrimp, known also as lake shrimp, prawn, and by various other names, spawns throughout the spring and summer in the open sea or gulf, beyond the three-mile limit and any State's jurisdiction. As soon as the young are hatched and passing through the larval stages, they begin those mysterious moves which are part of their life force.

The young move into the warmer shallow waters, their nursery. Then, as they grow, they move toward larger bodies of water. July finds them beginning to show up in the offshore fisheries. By the end of September they form the chief portion of the commercial catch, as immature shrimp.

Cold weather sends them into deeper waters offshore, where it is warmer. With spring and still warmer waters offshore, they reveal an increased growth rate. Food is more plentiful. They become adults. They spawn. And then they die.

At least, from all existing evidence this is their fate.

The Fish and Wildlife Service is pretty sure that they can't live longer than a twelvemonth, though it will require several years and much more experimental work to settle this question absolutely. No reward is offered for a shrimp over twelve months old, but anyone who can produce a specimen and prove its age is fairly certain of a lot of acclaim.

You can't tell age, by the way, from the size or structure, from the number of feelers, or from anything like that.

The story of shrimp is not complete without a closer glance at the shrimp investigations of the Fish and Wildlife Service, for by their careful, exhaustive work many of the mysteries are being solved. One of the chief forms of the investigations is the tagging of shrimp in order to study their life-cycle, migratory habits, growth rate, decrease through fishing, and the fate of the adults.

Tagging consists of placing small numbered disks on young shrimp, then releasing them to wander where they will. Fishermen are paid fifty cents for each of these recovered in their nets. They must give the approximate location where the drag was made and the date. Thus the growth and traveling habits are learned. Thousands of shrimp have been tagged and released, and thousands found and returned. One even came from Indianapolis, where it turned up in someone's salad! Most of the tagged ones don't travel quite this far, though distances of 300 miles between point of release and capture in a number of instances indicate that they do get about.

The search for shrimps

Another phase of the work carried on by the service is the dragging or sampling of the entire ocean floor from shore out to a depth of 600 feet, to determine where shrimp dwell and what types of areas they most commonly inhabit.

During one such dragging, in 1938, the greatest single shrimp fishery was found, a comparatively small, concentrated area located in the Gulf of Mexico off Morgan City, Louisiana. Out of this ground, first proved by the Fish and Wildlife Service dragging experiments, 200 trawlers now take as many as 90,000 barrels of big shrimp each year.

Carrying the tests further in 1939, the Service's experimental vessel *Pelican,* explored other parts of the area from the Mexican border to Carrabelle, Florida. Later the Service did the same on the South Atlantic coast to the northern limits of that shrimp fishery. On the Gulf alone, the trawl was dragged over 1200 miles of ocean bottom.

Among the valuable facts learned was that there no longer seemed to be any undiscovered concentrations of shrimp. The investigations also revealed that bottoms composed of sand, shell, or coral, do not provide suitable habitats for shrimp.

Though much has been learned, the job is far from done, says Milton J. Lindner, head of the Service's shrimp investigations. Several years and many more thousands of tags will be needed to obtain even part of the knowledge that Mr. Lindner and his associates feel is indispensable.

In other words, no one has yet really known the shrimp, though this creature is one of the best known sea dwellers.

M[illegible]

THE PRIVATE LIFE OF A WASP

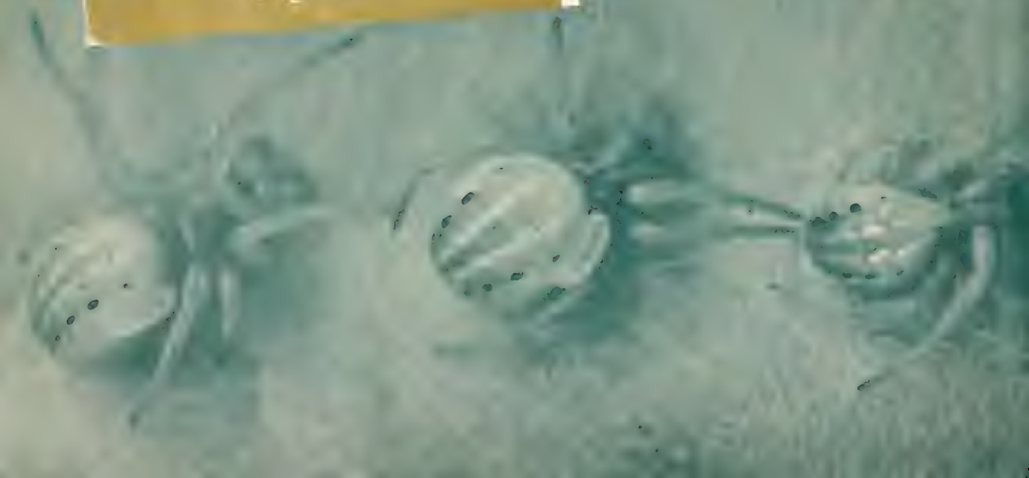
By Carl G., Philip E.
and
Paul A. Hartman

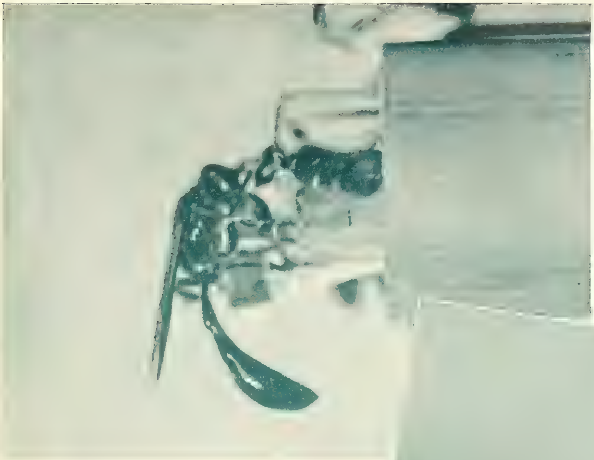
[illegible] row, or other unnoticed nook. Many persons have tacked bamboo tubes to their window sills, just as you might fasten a wren house to a tree, to see the wasps pass in and out and watch the female carry spiders and pellets of mud. But until recently what went on inside was in part obscure. When glass tubes are [illegible]

[illegible] to photograph this wasp by the glass tube and bamboo method, reveals that Madame Wasp is a past mistress in the task of providing for a family and a generation she will never live to see.

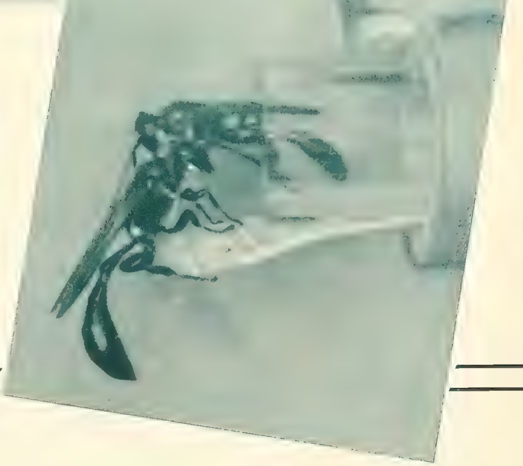
Before Madame Trypoxylon can create life she has to take it,—or rather she has to find a victim and reduce it to sort of suspended animation. The victim is an orb-weaving spider, which she skillfully paralyzes with a single jab of her stinger, so that it will remain [illegible]

1 On spiders paralyzed but not killed, Madame Wasp lays her eggs, thus providing fresh food for a generation she will never live to see



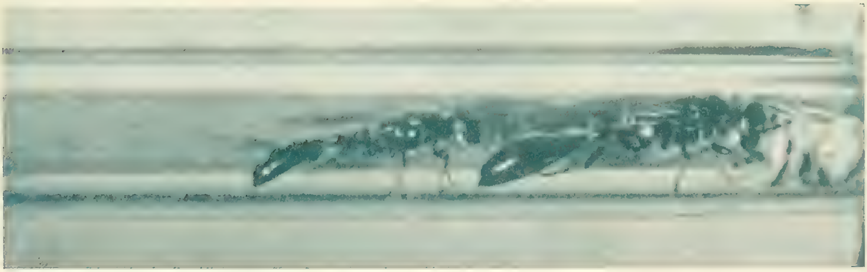


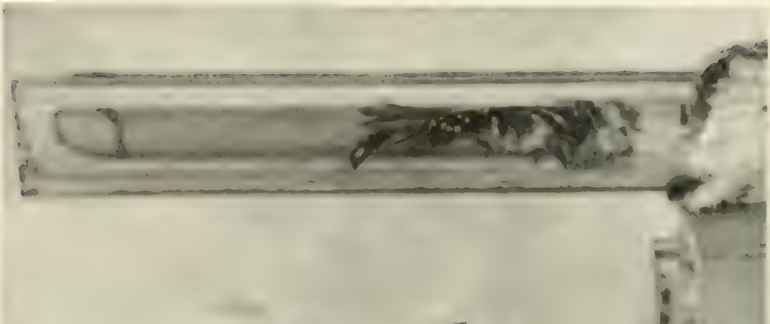
2 BUT FIRST Madame Wasp must bring the "sleeping" spider to the tube, which the observer has provided for her. At left, she is seen alighting with it at the entrance and being met by the male



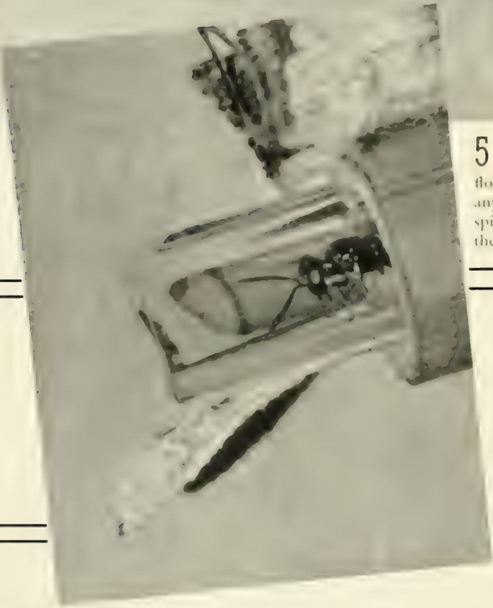
3 THE MALE mounts the female at the entrance and rides into the nest pickaback. The glass tube has been inserted in the bamboo one, from which it may be withdrawn so that the observer can see and photograph what is about to happen inside

4 BRINGING the spiders one at a time, Madame Wasp pushes them into a compact mass, while her mate sees that the job is well done





5 *(Above)* WHEN SHE DEPARTS, he tolerates no littering up of the floor with spiders. He at once does any necessary tidying, jamming the spiders back into the farther end of the tube



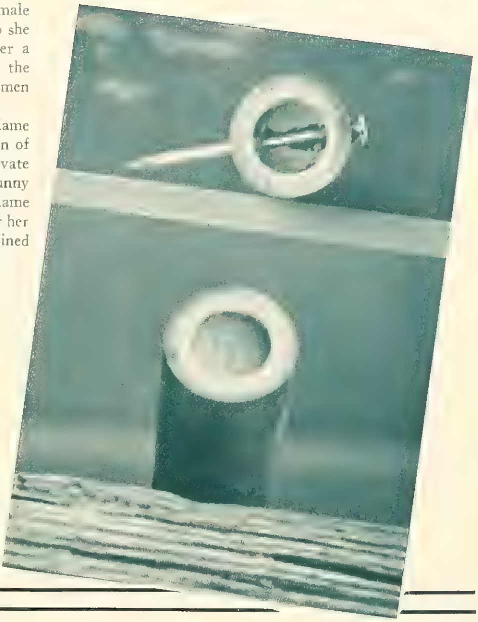
6 THEN HE RETURNS to stand guard at the entrance, continually vibrating his antennae alertly

THE [illegible] good [illegible] well he cannot fare forth as his mate can, saber in [illegible] the prey. But he guards the nest faithfully against cuckoo flies and wasps which are always present to lay their own eggs on the collected larder. And he gives his wife a glad welcome when she returns from her frequent trips abroad for provender and building material.

After about four or five spiders have been brought in, which may be a half-day's work, the female lays an egg on the last one, which is always large.

The egg-laying is quite a ceremony. The female is too large to turn around in the tube, so she turns around outside and backs in. After a period of pumping movements of the abdomen, the egg emerges and is laid across the back of the abdomen of the spider, affixed by a sticky secretion.

In sealing the nest shut from the outside, Madame Trypoxylon uses dry mud mixed with a secretion of her crop diluted with water. One wasp had a private quarry to which she was seen to come on every sunny day for six weeks, to roll up pellets of mud. Madame Wasp's husband cannot handle mortar, so it is for her to do all the necessary work of sealing the combined tomb and maternity ward.



7 When the last egg is laid, Madame Wasp walls the nest shut with a mud partition. The photographs at right show both ends of the tube sealed shut. The nail was used by the observer to fasten the tube in place

8 *(Above)* When the nest has been filled and sealed, the clear glass tube can be removed and studied with a magnifying glass under good illumination. The photograph shows the tube partitioned into three cells, one empty and each of the other two occupied by a large grub well on the way to wasphood

Thus Madame Trypoxylon has provided for the future of the new generation. When frost arrives the senile parents die. The grubs and pupae become dormant and remain so until the summer heat awakens them to the duty of reproducing as their parents did, and indeed their ancestors for millions of years past.

The activities of Trypoxylon can be observed widely throughout much of the world.

GEM FOR DECEMBER

By Frederick H. Pough

Savages the world over have prized the turquoise, while its fame for beauty and magic resound through the ages. Lapis lazuli is an attractive alternative

Below: Precious Lapis has gone east as well as west, to be worked by the Chinese in some of their delicate carvings

(Above) A VEIN of turquoise cuts through the matrix rock. From Los Cerrillos Mines in New Mexico

FROM the dawn of civilization, turquoise has played an important role in the lives of primitive peoples throughout the world. No important turquoise deposits are known today that do not show traces of having been worked by prehistoric man. The American Indian, the Aztec, the Egyptian, the Persian, and the Tibetan, all valued turquoise as one of the more precious materials.

This is easily understandable, for turquoise is an opaque mineral, one which depends for its attractiveness upon color, rather than upon brilliance and transparency. Primitive peoples did not facet and polish as we do today, and quite naturally the bright color of opaque stones had a greater appeal. This partly explains the wide use of opaque quartz gems,—bloodstone, jasper, sardonyx, and carnelian—, as well as turquoise and lapis lazuli (the latter, an alternative gem for December).

Turquoise is easily worked by primitive methods but does not take the polish of the harder stones. It is a phosphate of aluminum and copper, and owes its blue color to the copper it contains. Turquoise is one of the few gems whose color is chemically bound in the material; most are colored by impurities. The name comes from the French word for Turkish, probably because people referred to the gem as coming from the East, from Turkey. Orientals still prize it highly and have a proverb, "A turquoise given by a loving hand brings happiness and good luck." Shylock in *The Merchant of Venice* was seriously grieved at the loss of a turquoise ring which had brought him good luck. There is a tendency for blue stones to become greenish, because turquoise is a soft and rather porous gem, readily absorbing oil and dirt from the skin. Such a change was thought by some to be a sign of impending evil. Much old Navaho jewelry reveals this aging.

Spanish conquistadors found turquoise to be highly valued by the Indians of the Southwest. The mines at Cerrillos, New Mexico, which are among the largest deposits in this country, were actually operated by the Spaniards for a number of years. Kunz describes visiting the locality and observed that the Indians sold the small pieces at the rate of twenty-five cents a mouthful,—for there it was stored as they worked. That was in 1890. No doubt the Indians would ask more today. Fine blue stones are the most prized. Bits of brown or black matrix are often cut with the blue as an attractive foil. But turquoise is easily imitated, and the purchaser should be wary.

Many a stone which the ancients referred to as turquoise was undoubtedly lapis lazuli, December's alternate. This is also a blue opaque mineral but has a far richer, deeper, bluer color. The finest quality of lapis, a complex silicate of sodium and aluminum with some sulphur, almost invariably contains small flecks of iron pyrite. Pliny likened lapis to the night sky studded with stars.

This fine gem was of great importance as a pigment. Until recently lapis lazuli was the only source of the artist's ultramarine. Fra Angelico used this finest blue pigment, and his work is still famous for its lovely blues, five centuries after his death. Ultramarine was made by crushing hand-picked fragments of pure lapis lazuli. Because lapis was the most expensive color, azurite—a copper carbonate—often replaced in part the genuine lapis. This substitution would pass unsuspected for many years but was always revealed by time, for azurite can change to green malachite. Blue skies painted with inferior pigments became in time an unnatural green. Only ultramarine was permanent,—until a synthetic product of the same composition was introduced to take the place of the precious lapis.

The principal source of the highest quality lapis lazuli was the remote fastness of Afghanistan, a region surrounded with legends and terror. The stone containing the masses of blue lapiz, often in twelve-sided crystals, is still quarried by ancient methods. The rock is heated by fires, and water is then thrown over it, cracking loose large slabs. Other sources include Lake Baikal and Chile, but the quality in these localities is lower.

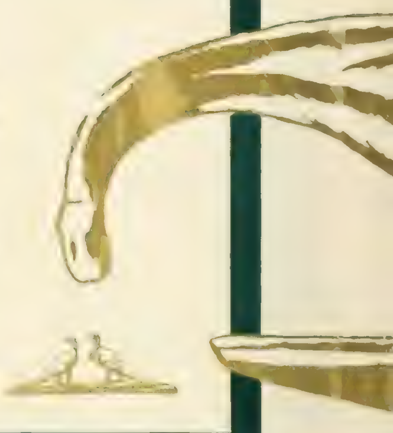
Lapis lazuli, under the name turquoise, was believed to be effective against the sting of scorpions and reptiles, and to prevent accidental death. About 50 A.D. Dioscorides recommended that lapis should be drunk for internal ulcerations and for growths in the eyes, and said that the stone would even glue broken membranes together. Later it was thought to be a cure for melancholy.

The name means blue stone. Therefore, the confusion between the two blue stones —turquoise and lapis lazuli—is not surprising. We may accept them both as the jewelers' choice of birthstones for December. But one might wish that for so cold a month a more warmly colored stone had been selected.

THE RISE OF THE
Dinosaurs

By ERICH M. SCHLAIKJER

"Leaping Lena," humble forerunner of creatures that could nibble leaves "four stories" above the ground, gave little promise that her race would **rule the earth for 140 million years**



At right: The 75-foot "thunder lizard," representing the Golden Age of Dinosaurs, looks back 50 million years at a pair of early dinosaurs only a yard long

[illegible]

B[illegible] What is the biggest thing in the biggest hall in the Museum—yes, in any museum. It's a dinosaur, or "terrible lizard," as the word is usually translated from the Greek.

Even a hundred years ago these ungainly looking things were called dinosaurs. Not all of them, however, are so big or so terrible. This name, though of little scientific standing, is used for the greatest and most diverse group of animals on record. Some were small—no bigger than a jack rabbit and very meek in appearance; others, in fact most, were quite terrible looking. They came into existence 200 million years ago at the beginning of the Mesozoic era, or Age of Reptiles, spread over the whole earth, and then vanished after 140 million years of triumph.

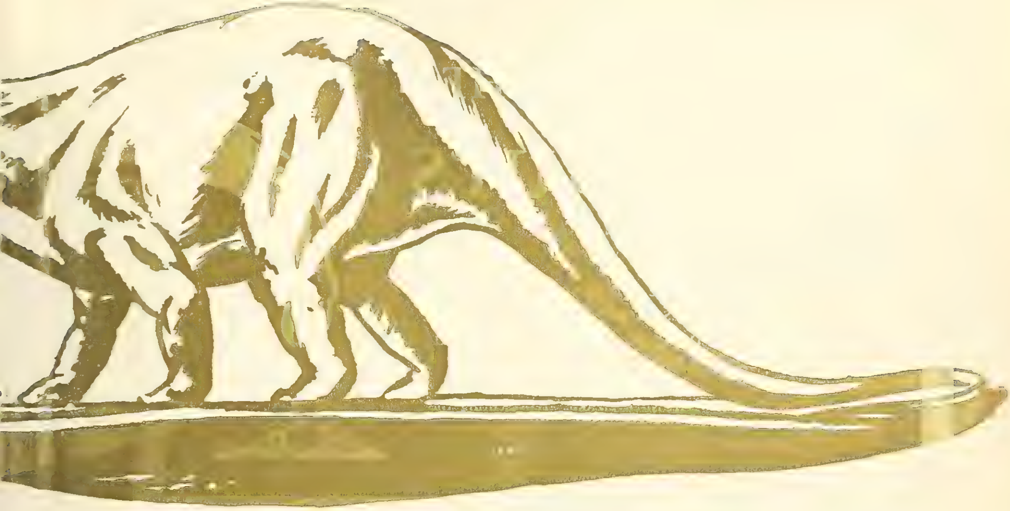
One hundred and forty million years is a long time for any group of animals to rule the world, but the dinosaurs were by far the most abundant and diversified land-living creatures throughout all that time. The life span of any group depends on its ability to cope with the vicissitudes of a changing environment. "Change with me or you die," is environment's command to all life. Because the dinosaurs were plastic they could change, and they evolved into bigger, and so far as they were concerned, better forms. But it was this very demand for change that led them into the inevitable pitfalls of overspecialization, and when the greatest of all climatic changes the reptiles had ever seen came at the close of the era, they could not meet the new demands.

At the beginning of the Age of Reptiles, the earth was still in the grip of one of the most effective revolutionary periods in its history—the so-called Appalachian Revolution. On every continent, mountain building and erosion, with the deposition of vast blankets of debris under semiarid climatic conditions, were the order of the times. In North America, relentless compressional forces had formed a great chain of mountains along the eastern seaboard from Nova Scotia to Alabama, of which our present Appalachians are the mere roots. When these forces gave way, the earth's crust snapped and broke all along the eastern flank of this chain, forming a lofty series of blocks and deep basins. This took place in the early Triassic period—so named because in Europe the extensive rocks laid down during that time are clearly separable into three distinct units.

Throughout the later part of this period, the block mountains were gnawed away by erosion, and the basins gradually became filled with debris—deposits which attained a maximum thickness of more than 20,000 feet. Great sheets of molten rock then forced their way up into these deposits and escaped here and there to form lakes of seething lava. These eventually cooled and were buried under more blankets of fine muds.

By the close of the Triassic, this great interior area, flanked by the high ancestral Appalachians on the west and by less lofty mountains on the east, was a nearly featureless plain. That its climate was arid is revealed by the prevalence of mud cracks, indicative of long periods of drying, also by the "desert red" color of much of the deposits, and by other evidence. There were local areas, however, where the climatic conditions were more acceptable and where life was fairly common. Fishes were abundant in the permanent lakes. And the presence of many fossil ferns, cycads, etc., shows that the humid localities were densely clothed with vegetation.

It was in these more favorable places that tiny,



primitive, crocodile-like reptiles and some of the first dinosaurs lived. Fossil remains of these are extremely rare, but their footprints in the rocks are numerous. It seems strange that so many footprints and so few bones have come to light. Probably the regions most suitable for the reptiles were close to the mountains in higher, cooler, wetter places, which have since been worn away by the elements. From these places, the reptiles wandered over the great inhospitable mud flats, leaving the impressions of their feet "on the sands of time." Only an occasional straggler died by the wayside, and it is his bones that we find.

In western North America the setting was not so uniform. Narrow arms of the sea occupied parts of the Pacific Coast region throughout the period, and in these narrow troughs, thousands of feet of marine sediment were laid down. At times, an arm of the sea would extend inland several hundred miles, as far as western Wyoming or even to western South Dakota. As these retreated, streams from the near-by surrounding mountains followed them carrying mud and silt. Our greatest deposit of such continental material laid down in this period extends from Utah to western Texas and in some localities is over 4000 feet thick. The plants and animals likewise were similar to those then in the east. Also, the fossil logs in the Petrified Forest of Arizona tell us that lofty evergreens clothed the uplands of that time.

Nor was all quiet on the western front of North America in regard to volcanic activity. The whole coastal area was peppered with volcanoes that belched forth clouds of ash. Thousands of feet of erupted material make up most of the Triassic rocks of certain islands on the southwest coast of Canada.

Such were the conditions in the world when the dinosaurs were born. But what are dinosaurs? What was their ancestry?

In size they ranged from twelve inches to 80 feet long—or just about one-third of a city block. In the beginning they all walked on their hind legs, and some kept this method of getting around, becoming more and more highly specialized in it. Others became thoroughly adapted to walking on all fours. Still others did a little of both. The skeletons of some were lightly built and bird-like. These were fleet-footed runners—at first flesh-eaters, later herbivorous. Some of the early flesh-eaters evolved into enormous destroyers of life—the Panzer division of the Age of Reptiles. There were gigantic forms that were at home both on land and in water. Others had horned heads or were heavily armored.

The dinosaurs are indeed so diverse that it is difficult to name features common to all. When we think in terms of an 80-foot *Brontosaurus* or a gigantic *Tyrannosaurus,* what we mean by a dinosaur seems perfectly clear. But some of the first types were almost indistinguishable from some members of another very generalized group of reptiles, the Pseudosuchia ("false crocodiles"), which lived in the same period. The evolutionary change from this group to the dinosaurs was so gradual that it is only in minor details that the two can be separated.

One of these borderline cases had hind legs over twice as long as its front ones. For popular purposes let us call this little animal Leaping Lena, for leap it certainly did, and the diminutive Lena is fitting for an animal that was only a foot long. Its scientific name, *Scleromochlus,* is more difficult to remember. The fossil expert examines the shoulder and hipbones in his effort to tell whether an animal is a dinosaur or not. Leaping Lena had no collarbone (clavicle) or

[illegible]

[illegible] The [illegible]

[illegible]

[illegible] earliest from North America the front legs may have [illegible] long and slender. Their skulls were equipped with relatively large eye sockets, and many had small teeth [illegible]

[illegible]

Various types of Lightweights have been discov[illegible] plains of what is now Scotland. In life he was no more than three or four feet long. His little skeleton [illegible] ancestor of the later members of this fleet-footed group of dinosaurs, whose evolutionary development, like that of the Meat-eating dinosaurs, became more and more progressive until near the close of the Age of Reptiles.

[illegible] because they were the only dinosaurs that ate flesh but [illegible] carnivorous life than any other and because their members became the most destructive flesh-eating ma[illegible] zer unit ever invented. Some, especially the earliest ones, were quite small, but others attained a height of over 20 feet. There is some difficulty in separating some of their earlier members from the Lightweights.

The Meat-eaters all walked on their hind legs, and [illegible] All had big heads with large, dagger-like teeth, the [illegible] est teeth on the side of the mouth were always [illegible]

[illegible] not especially abundant, were well established. The [illegible] the starting point of all the later forms. This beast was about ten feet long and was already adapted for [illegible] were specialized for cutting, and his hands were of the grabbing type, with large curved claws on the [illegible]

[illegible] were the forerunners of the third group, the Land-and-water forms. They were very widely distributed over the world, having been found in North America, [illegible]

Grandfathers of the giants

They were small to medium-sized dinosaurs which usually walked on their hind legs, although some spent part of the time on all four. They had long necks and small heads, and their small, pointed or spatulate teeth were still best adapted for eating small reptiles, fish, or soft-shelled invertebrates. Some may also have been partially herbivorous. An eight-foot creature called *Thecodontosaurus* is the earliest [illegible] why he makes a good ancestor for all the rest, and for the later giant sauropods. By the close of the Triassic some had become specialized and had departed from the trail of evolution leading to the later giants. [illegible] animal that got to be 20 feet long. He is known from a number of fine skeletons which were preserved when the animals died in desert regions of prehistoric France and Germany and were covered by wind-blown material.

These dinosaurs are important because they were the most abundant dinosaurs of the Triassic and be[illegible] plentiful group of the next geologic period, some of [illegible] animals.

Coming to our other main division, we find that the ornithischian dinosaurs, or those with bird-like hip-bones, were much slower on the evolutionary pickup than were the types we have just discussed. Almost no trace of them has been found in the first period in the Age of Reptiles—only one fragmentary skeleton, found in Colorado, and footprints indicating three other forms. But they must have been quite varied and widely distributed by then, because at the very begining of the next geologic period their remains show definite specialization into two distinct lines.

The second phase in the rise of the dinosaurs took place in the Jurassic period, which gets its name from the Jura Mountains between Switzerland and [illegible] great block of Jurassic limestone that had accumulated on the floor of the sea and was brought to the surface by later fracturing of the earth's crust. Thick Jurassic deposits also occur in India, Australia, southern Africa, and South America.

In North America not a grain of Jurassic rock is to be found anywhere east of the Mississippi River. This great region was being worn down, not built up, throughout the period. Just the reverse was true on the west coast, where sediments accumulated in the long, narrow seas that penetrated inland. In what is today the Rocky Mountain region, conditions were different. A vast trough-like lowland was present, with a long, narrow mountain chain to the west. At first this basin was wind-swept and arid, but as time passed, warm shallow waters came creeping in from the north, ultimately reaching as far south as northern Arizona. Just to the south, arid conditions continued to prevail, and vast deposits of wind-blown sands were piled up. Towards the close of the period, the land tilted up, and great meandering streams flowed sluggishly eastward across this region, spreading out a blanket of muds and sands over an area of 100,000 square miles.

Lands of plenty

Along Jurassic streams such as these, on the margins of seas, and in the swamplands densely clothed with vegetation, the dinosaurs evolved abundantly. There were many other forms of life, too,—flying reptiles, turtles, lizard-like creatures, and crocodiles. More than a thousand different kinds of insects—flies, moths, cockroaches, termites, etc.—are known to have lived there. Primitive mammals became more and more numerous, and the first birds appeared. The seas swarmed with invertebrate life. Some coiled mollusks reached a size of six feet across. Schools of great porpoise-like marine reptiles swam along the shores of every continent.

In these surroundings, the dinosaurs began making their first real evolutionary splurge. The Lightweights became more abundant as time went on. Their best-known representative was a creature that stood about two feet high at the hips and was over seven feet from nose to tip of tail. His name, *Ornitholestes,* means "bird robber"—because at his christening it was erroneously thought that his long, curved foreclaws were suitable for catching primitive reptile-like birds. Closer inspection shows no bird-in-the-hand for *Ornitholestes,* for his much elongated and very compact hand probably couldn't have held a bird even if one had flown right into it. He could have eaten birds though, because his small carnivorous teeth were well adapted for such work.

The true Meat-eaters also became more abundant and more widespread during this period. There was little danger of extinction for these marauders in the lands of plenty. They grew to be nearly 40 feet in length and were well able, with their grasping claws and knife-like teeth, to take on even the largest of the giant dinosaurs, called sauropods.

One of the nastiest of these creatures was the North American *Allosaurus,* whose main diet probably consisted of sauropod steaks. Evidence of his slaughterous feats is written on the remains of a large sauropod found in Wyoming. The spines projecting from the backbone of this victim had been bitten off, and the teeth marks match the teeth of *Allosaurus.*

The Land-and-water dinosaurs, or sauropods, are perhaps the best known to the general public. After all, once you see an animal 80 feet long it's difficult to forget it. Not all were as big as that, however,—some were only 40 feet long. The sauropods were by far the dominant group of the Jurassic period.

Not only were they distinctive in their great size, but they were all short-bodied, long-necked, long-tailed, small-headed, literally almost brainless individuals. One of the largest had a brain no bigger than a man's fist. But these creatures were equipped with an additional "brain" that was twice as large as the real brain and was located in the spinal column in the hips. It wasn't really a brain but a sort of relay-station to transmit to headquarters what was going on behind.

The sauropods walked on all fours, that is, when they walked. It is questionable whether they came out on land at all, because the limb joints were of cartilage instead of firm bone. That a 30- or 40-ton animal could support all his weight on such limbs seems unimaginable. It was more likely that they spent all their time in the shallow water along the shores of lagoons and lakes, walking over the muddy bottoms where at least part of their weight was supported by the water.

Stones to aid digestion

Their heads were relatively small and had peg-like or spoon-shaped teeth wholly unadapted to eating flesh but very serviceable for gathering vegetation. They didn't have to eat as much as one would think, however, since their metabolism probably was low. The type of teeth shows that they could not have chewed their food. What they swallowed was taken care of by their gizzard-like stomachs and stomach-stones, or gastroliths *(see cover and page 294).*

The bodies of these huge creatures were covered with skin having a surface of small, low tubercles, set close together, but arranged in no regular pattern. Discovery of this was made in 1934 by Dr. Barnum Brown when the American Museum-Sinclair Expedition collected parts of some 20 skeletons from the Howe Quarry near Cody, Wyoming.

Quite a number of different kinds of sauropods have been found. The oldest known member is called *Cetiosaurus,* which means "whale lizard." *Cetiosaurus* is, of course, unrelated to the whales, but is a whale of a big dinosaur, for in length he was around 50 feet. He is a genuine sauropod, though in structure rather a primitive one. He makes, therefore, a good structural ancestor for nearly all the later Jurassic forms.

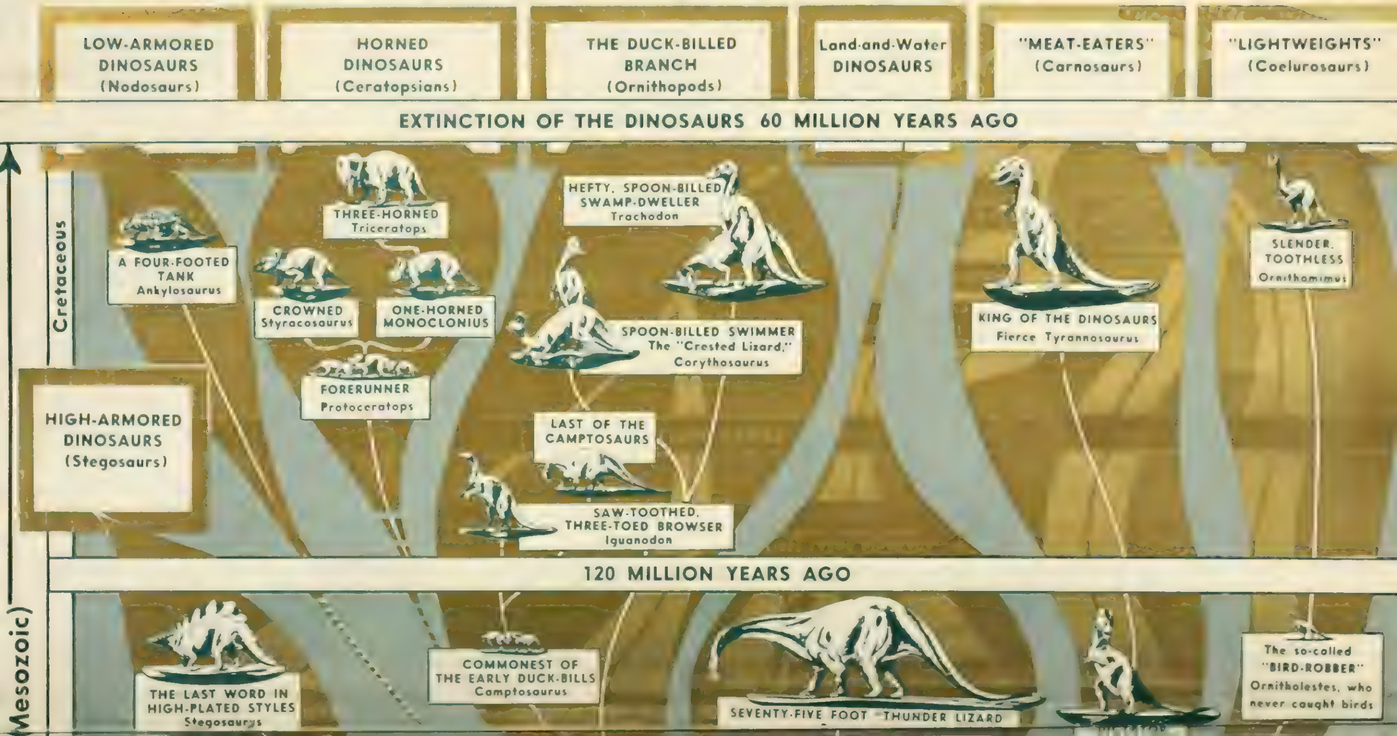
One of the most familiar of later sauropods is the "Thunder Lizard" (*Brontosaurus*). He got to be around 75 feet in length, but the long "whiplash" ending of the tail accounts for ten or twelve feet of that. He stood about fifteen feet at the hips.

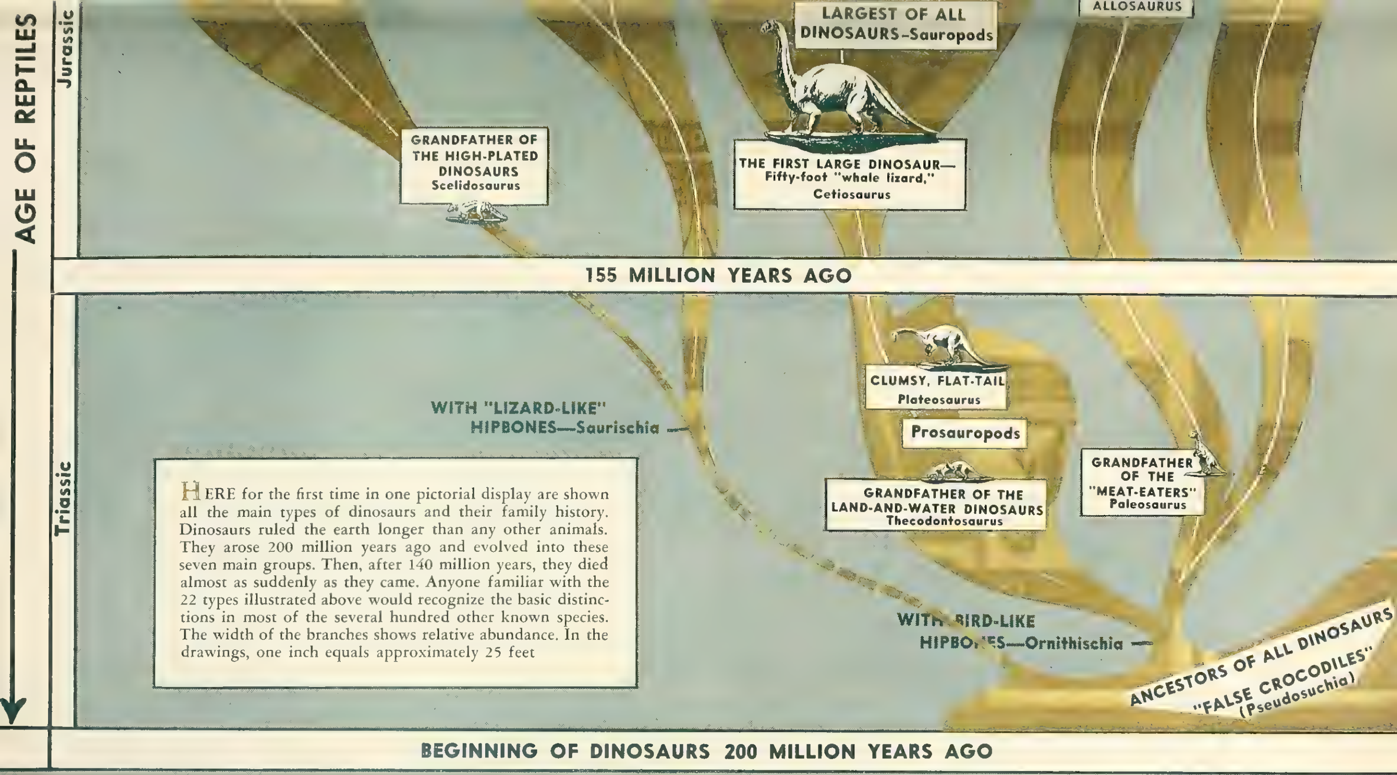
For sheer bulk, the champion dinosaur is *Brachiosaurus,* a native of both North America and eastern Africa. Portions of several skeletons—one rather complete—of this spectacular giraffe-like beast are known. The skeleton is mounted in the Berlin Museum. This specimen shows that the tail is short, but

Continued on page 303

Family Tree of the
DINOSAURS

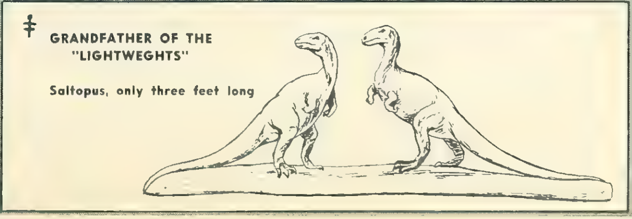
By BARNUM BROWN *and* ERICH M. SCHLAIKJER


LOW-ARMORED DINOSAURS (Nodosaurs)
HORNED DINOSAURS (Ceratopsians)
THE DUCK-BILLED BRANCH (Ornithopods)
Land-and-Water DINOSAURS
"MEAT-EATERS" (Carnosaurs)
"LIGHTWEIGHTS" (Coelurosaurs)
EXTINCTION OF THE DINOSAURS 60 MILLION YEARS AGO
Cretaceous
A FOUR-FOOTED TANK Ankylosaurus
THREE-HORNED Triceratops
CROWNED Styracosaurus
ONE-HORNED MONOCLONIUS
FORERUNNER Protoceratops
HEFTY, SPOON-BILLED SWAMP-DWELLER Trachodon
SPOON-BILLED SWIMMER The "Crested Lizard," Corythosaurus
LAST OF THE CAMPTOSAURS
SAW-TOOTHED, THREE-TOED BROWSER Iguanodon
KING OF THE DINOSAURS Fierce Tyrannosaurus
SLENDER, TOOTHLESS Ornithomimus
HIGH-ARMORED DINOSAURS (Stegosaurs)
120 MILLION YEARS AGO
(Mesozoic)
THE LAST WORD IN HIGH-PLATED STYLES Stegosaurus
COMMONEST OF THE EARLY DUCK-BILLS Camptosaurus
SEVENTY-FIVE FOOT "THUNDER LIZARD
The so-called "BIRD-ROBBER" Ornitholestes, who never caught birds


AGE OF REPTILES
Jurassic
Triassic
LARGEST OF ALL DINOSAURS–Sauropods
ALLOSAURUS
GRANDFATHER OF THE HIGH-PLATED DINOSAURS
Scelidosaurus
THE FIRST LARGE DINOSAUR—
Fifty-foot "whale lizard,"
Cetiosaurus
155 MILLION YEARS AGO
CLUMSY, FLAT-TAIL
Plateosaurus
Prosauropods
WITH "LIZARD-LIKE" HIPBONES—Saurischia
GRANDFATHER OF THE LAND-AND-WATER DINOSAURS
Thecodontosaurus
GRANDFATHER OF THE "MEAT-EATERS"
Paleosaurus
WITH BIRD-LIKE HIPBONES—Ornithischia
ANCESTORS OF ALL DINOSAURS
"FALSE CROCODILES"
(Pseudosuchia)
BEGINNING OF DINOSAURS 200 MILLION YEARS AGO

HERE for the first time in one pictorial display are shown all the main types of dinosaurs and their family history. Dinosaurs ruled the earth longer than any other animals. They arose 200 million years ago and evolved into these seven main groups. Then, after 140 million years, they died almost as suddenly as they came. Anyone familiar with the 22 types illustrated above would recognize the basic distinctions in most of the several hundred other known species. The width of the branches shows relative abundance. In the drawings, one inch equals approximately 25 feet

Drawn by
Alastair Brown
from models by
Georgia Mary Whitman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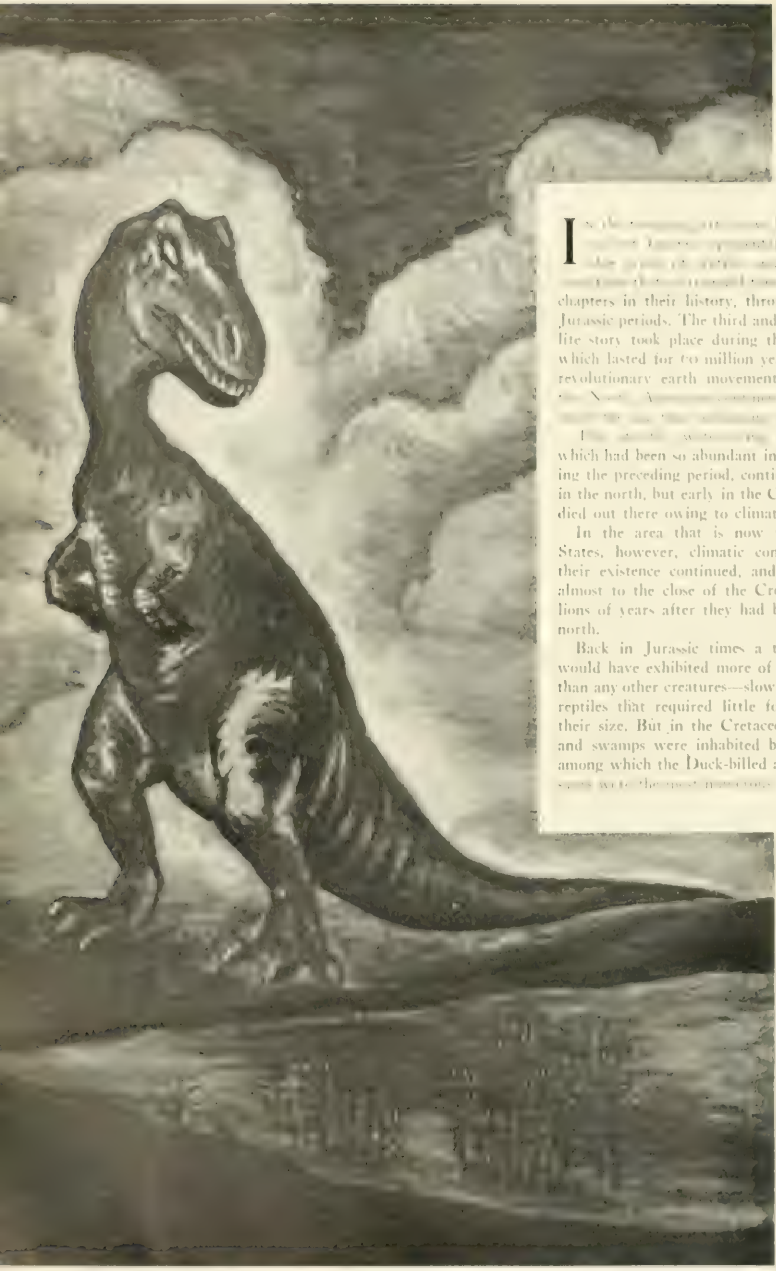
GRANDFATHER OF THE "LIGHTWEGHTS"
Saltopus, only three feet long

Natural History Magazine, December, 1941

THE



I[illegible] chapters in their history, through the Triassic and Jurassic periods. The third and final chapter of their life story took place during the Cretaceous period, which lasted for 60 million years. During this time revolutionary earth movements caused portions of the North American continent to [illegible]

The [illegible] sauropod dinosaurs which had been so abundant in North America during the preceding period, continued for a short time in the north, but early in the Cretaceous period they died out there owing to climatic changes.

In the area that is now the southern United States, however, climatic conditions favorable to their existence continued, and there they persisted almost to the close of the Cretaceous period—millions of years after they had become extinct in the north.

Back in Jurassic times a typical lakeside scene would have exhibited more of these huge sauropods than any other creatures—slow-moving, cold-blooded reptiles that required little food in comparison to their size. But in the Cretaceous period the glades and swamps were inhabited by more varied types, among which the Duck-billed and the Horned dinosaurs were the most numerous.

TYRANT KING OF THE DINOSAURS, *Tyrannosaurus rex*. This largest flesh-eating animal that ever walked the earth had a sharp nose for blood and carrion, but the days of his rule were numbered

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LAST DINOSAURS

By BARNUM BROWN[1]

Curator of Fossil Reptiles, The American Museum of Natural History

It was the era of spectacular armaments, but even Dictator Allosaurus and the four-footed tanks went down before world conditions with which they could not cope

The beginning of the Cretaceous period marked the advent of a highly diversified plant life. Whereas the only type of flowering plants known in the previous two periods were the cycads, the landscape now developed a flora almost as varied and abundant as it is today. Undoubtedly this change in the vegetation influenced the diversification of dinosaurian life during the Cretaceous period.

It is impossible to speak of dinosaurs—a great order of creatures which existed for so many millions of years—without becoming philosophic. They were one of Nature's greatest experiments—a bold venture along new lines. Various forms were tried out, under various circumstances; but after 140 million years, all were thrown into the discard. "All?" you may ask. "Might not some explorer discover descendants of the dinosaurs living today in some hidden corner of the world?" The thought is a romantic one, but I am sorry to say the chances are nil.

Most extinct creatures have left some living descendants or not too distant relatives that give definite clues to their peculiarities and habits, but the dinosaurs left none. As we know them today they suddenly appeared in the Triassic period, 200 million years ago, and they as suddenly ceased to exist near the close of the Cretaceous, 60 million years ago. Our real knowledge of the group goes back only 100 years, when footprints were first found in the Connecticut Valley and were thought to be the tracks of Noah's raven. Since then hundreds of skeletons and incomplete remains of dinosaurs have been classified and exhibited in museum halls, yet every active institution has in its storerooms countless specimens—single bones, fragmentary bones, and teeth—as yet unclassified, of doubtful identity, or entirely new. Many of these, insufficiently understood and too doubtful to bring to light, will remain unpublished until we can learn more definitely of their relationships.

Dinosaurs are so remote from the experience of most people that perhaps the best way to make these dry old bones come to life is to examine the equipment with which Nature endowed them, and to see them perform. If we can see what made the wheels go round, instead of merely pigeonholing them with names and classifications, we may know better what it would have been like to be a dinosaur.

Several hundred species of dinosaurs have been determined; yet we know that these represent only a fraction of the once numerous population. It is indeed a poor season when an expedition does not uncover one or more new species. Realize that all of the combined exposures of dinosaur-bearing rocks represent only a tiny percentage of the accumulated sediments laid down during dinosaur days. Where the dinosaur-bearing beds are being weathered away, each rain may expose specimens previously covered. So we search the same areas year after year and find new specimens. Classic fields will continue to reveal new forms as erosion goes on. And new beds are continually being discovered.

In favorable places dinosaur footprints are found in great numbers, and they are so varied in form that only a few general types have been identified as belonging to creatures whose skeletons we already know. Literally thousands of tracks have been found in the Triassic rocks of the Connecticut River Valley, representing a great many distinct forms. Yet only twelve species of dinosaurs are known by incomplete skeletons from these same rocks.

The rarity of dinosaur bones in this welter of tracks is one of the great mysteries of the past. Possibly it is to be explained on the grounds that the bones were too delicate for preservation in these particular sediments. In spite of their size, the bones of living dinosaurs were probably as delicate as are those of our present-day salamanders. As fossils, the large bones of dinosaurs are extremely heavy, but most of the weight is made up of rock that fills the cavities in the bones—cavities once filled with air. Changed to stone as they are now, it is difficult to appreciate their original lightness and fragility.

In other places, where dinosaur remains were mingled with great masses of vegetation, the skeletons probably were destroyed by humic acid generated during the changes brought about in the formation of coal. Notable examples of this kind were found by the American Museum-Sinclair Expedition of 1937 in the coal fields of Wyoming.

Few skeletons of young dinosaurs

Another mystery connected with dinosaurs is that we find so few bones and skeletons of the young as compared with the vast number belonging to adults. There are only a few cases on record where we can say definitely that the individual was a young animal of a kind known by adult skeletons. Water was necessary for the bones to become fossilized, and it was also essential in the life of the vast majority of dinosaurs. Even semiaquatic creatures of today, such as turtles and crocodiles, lay their eggs away from water. And it has been satisfactorily determined that the egg-laying dinosaurs deposited their eggs in sand

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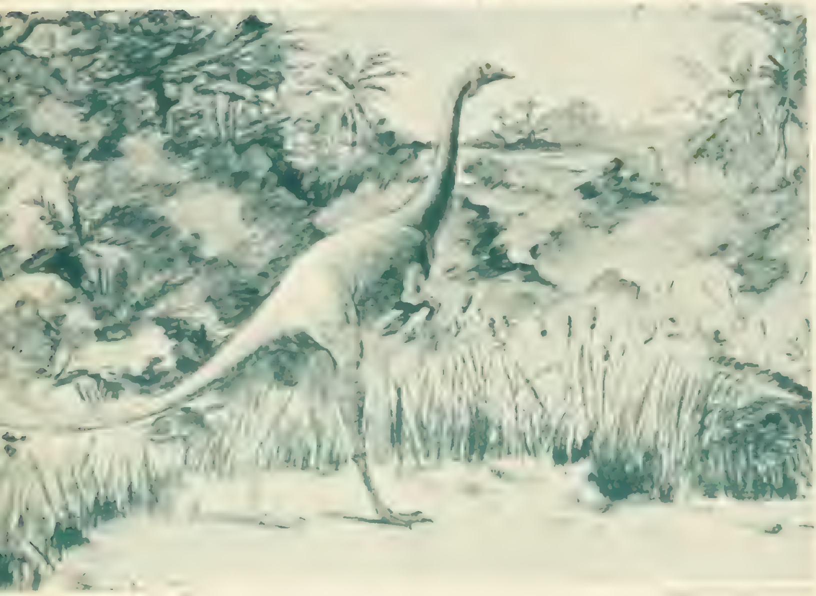
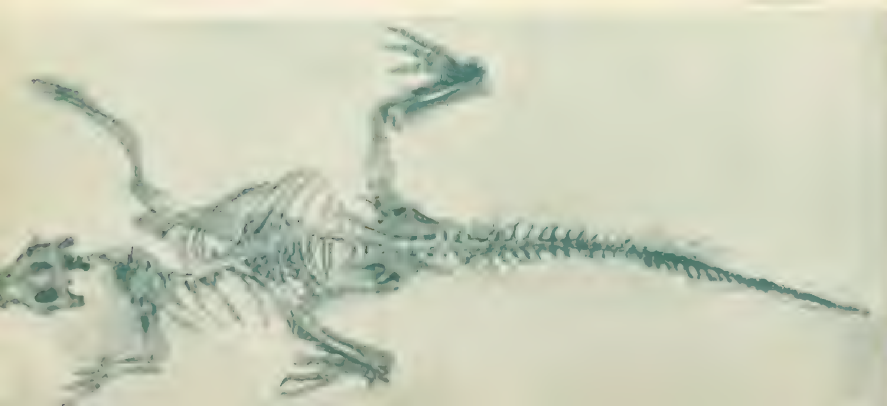
[1] For a biographical sketch of Doctor Brown, please turn to page 308.

A DINOSAUR TREASURE GROUND



(*Above*) A DINOSAUR that looked like an ostrich: *Ornithomimus*, one of the last Lightweights. This toothless animal, which departs so widely from the popular idea of a dinosaur, was about 6 feet tall and may have lived on crustaceans

(*Below*) GIZZARD STONES. Various kinds of dinosaurs probably swallowed stones which served to grind their food. Here a large number of small stones can be seen among the ribs exactly as found in a small dinosaur in Mongolia



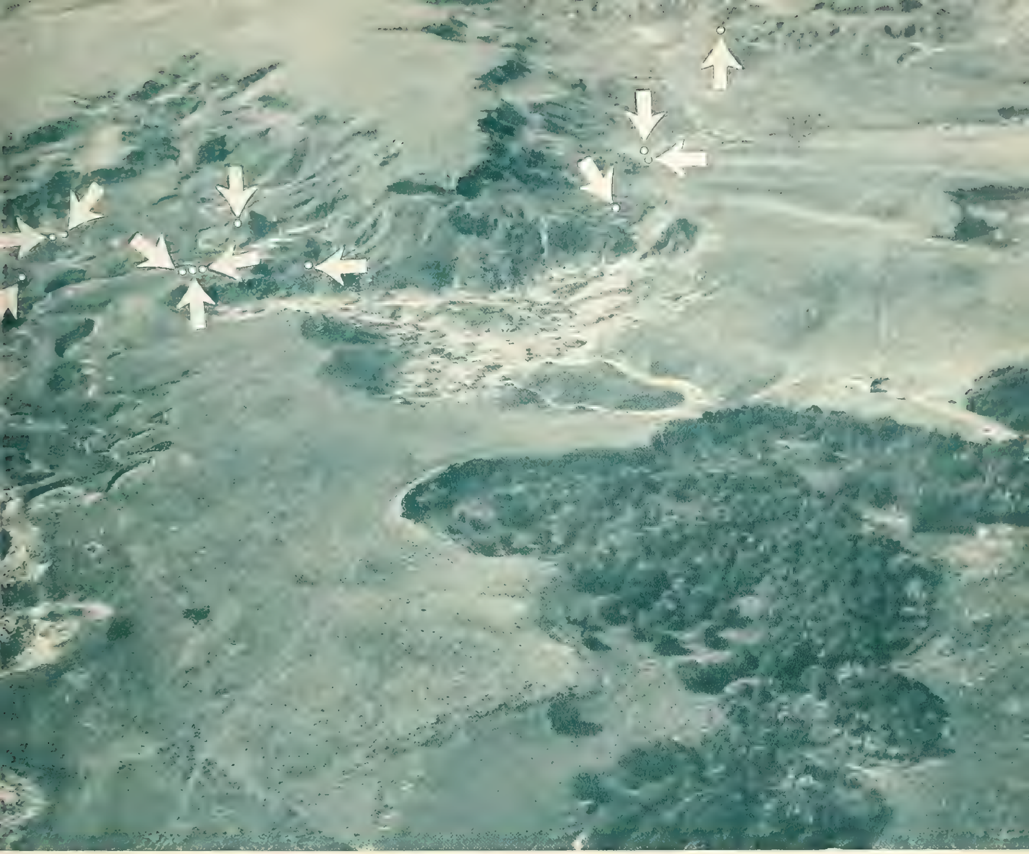
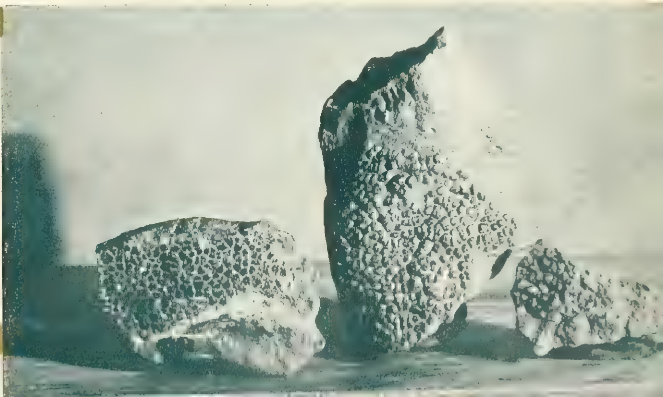


Photo by Barnum Brown

A DOZEN FINE DINOSAURS have been taken out of this one area, 40 miles southeast of Billings, Montana, on the Crow Indian Reservation. Dinosaurs are found where rock edges are exposed along steep slopes. Such exposures represent only a tiny fraction of the total beds laid down during the time of the dinosaurs. Yet it is a poor season when an expedition does not return with one or more dinosaurs new to science

THE OLDEST unaltered animal substance known: skin at least 120 million years old. The left-hand piece shows the actual skin of a dinosaur. The other two, though less spectacular as examples of preservation, both give a clear impression of the surface texture. Sectioned under a microscope, the skin shows a structure similar to the shed skin of a living snake or lizard. Other dinosaurs had distinctive skin patterns like some of our modern reptiles

Photo by American Museum-Sinclair Dinosaur Expedition of 1934



[illegible] water to fossilize their bones.

[illegible] probably represent young animals. The great number of individual remains found together in favorable places and in definite growth stages indicate multiple births as in living reptiles.

How long did dinosaurs live? We can only guess. Their growth and development was probably rapid in spite of their sluggish habits and small consumption of food.

The oldest unaltered tissue

Our efforts to discover what these creatures were like in life are, of course, hampered by many obstacles resulting from the millions upon millions of [illegible] But we [illegible] in knowing even the texture of their skin in some cases. Among the huge four-footed, long-tailed sauropods, a section of tuberculated skin pattern was found on a single leg bone in England; and in the great Howe Quarry in Wyoming we found isolated loose patches of skin impression all over the quarry—indeed, impressions not only of the skin pattern but the actual skin substance itself. This has been sectioned and studied under the microscope and it shows a structure similar to the shed skin of a snake or lizard. This is the oldest unaltered animal substance known, approximately 140 million years old. The surface of this skin is composed of small, low tubercles or bumps, the size of a pinhead, not overlapping as in the scales of fishes or snakes or in the mosasaurian (marine) reptiles. There is no evidence of a color pattern, nor can we be certain which type of animal this skin covered. But as most of the remains were of sauropods, the skin in question presumably came from these sauropod animals that were [illegible] feet long and twelve feet high, with heads a foot long and brains that weighed an ounce!

Our knowledge of the skin of the Duck-billed dinosaurs, the most numerous of the Cretaceous dinosaurs, is much more specific. We have every authority for saying that the different species could be distinguished by skin patterns as clearly as are the different genera of modern lizards. Many specimens are preserved with the skin impressions immediately overlying practically all parts of the body. So completely do the skin impressions "clothe" two bodies that they have been called mummies, although no part of the actual skin substance was preserved.

Among the Duck-billed dinosaurs, the different [illegible] patterns of tubercles of characteristic size and shape. Large rosettes were distributed in rows down the belly and upward over the back, with the individual tubercles larger and more uniform in general character over all the tail surface. This wrinkled skin was evidently so tough that when the carcass was covered with soft silts during burial it resisted decomposition for a long time while the silts were hardening, thus forming a clear-cut impression. Later the skin [illegible] the impressions were preserved with exact fidelity as to form and pattern. In other species we find uniform impressions without pattern arrangement. At present we are of the opinion that the [illegible] Duck-billed dinosaurs lacked [illegible] pattern arrangement and that some of them may have been variously colored like modern lizards. Probably this group lived for the most part in the water. Sometime in the future when a sufficient number of Duck-billed specimens have been recovered it will be possible to assign definite skin designs to the various species and to identify the creature by them even as we do now by skeletal features.

Among the Horned dinosaurs of the same period several specimens have been recovered with patches of skin impression preserved, and in these forms there is also a definite series of rosette-like patterns on the sides of the belly.

[illegible] dinosaurs such as *[illegible]* [illegible] were huge slow-moving armored "tanks," some of them fifteen feet long, five feet high, and six feet wide. The back and sides of these animals were covered with rows of plates running crosswise and lengthwise like those of modern alligators and crocodiles. An epidermis or outer skin, which was similar in form and pattern, covered these plates. Plates of smaller size, varying in form and size so as to permit movement, covered the belly and legs. This numerous and varied group of dinosaurs resembled enormously enlarged, drawn-out "horned toad" lizards.

Gizzard stones

Chickens and other gallinaceous birds swallow stones which serve the purpose of grinding their food in the gizzard or pro-stomach. Some extinct animals such as plesiosaurs regularly followed this same practice, and there is no doubt that certain types of dinosaurs also swallowed stones. A skeleton of an orthopod dinosaur from Mongolia now in the American Museum has 112 stones preserved within the body cavity. With another specimen—one of the large sauropod dinosaurs of the type of *Barosaurus*—seven highly polished stones were preserved with the vertebrae, and it is practically certain that these stones had been in the dinosaur's body when it died.

In some fields where dinosaur skeletons are numerous, as in the Lower Cretaceous beds of Montana, we find literally thousands of highly polished stones that probably were regurgitated by dinosaurs after the stones became rounded and therefore no longer useful as grinders. None of these highly polished stones were found in the body cavities of skeletons from the same beds. We did, however, find such stones while excavating one of the skeletons, and they show the same high polish as those found exposed in the surface layers. In another place where a great number of skeletons were found together, in the Howe Quarry of Wyoming, there were 64 well-polished stones under the shoulder blade of one of the large skeletons.

These are a few examples in which the implication is quite conclusive that some sauropods, as well as other types of dinosaurs, had the habit of swallowing stones as an aid in digesting food. Our difficulty, however, is to explain the high polish found on the supposed stomach stones (gastroliths), because among the modern birds, hard objects such as glass are etched rather than polished in the gizzard. In our opinion the polishing took place by some unknown process in the alimentary canal of these dinosaurs. The highly polished stones are invariably found in rock layers that contain dinosaur skeletons and they are not found elsewhere.

The teeth of dinosaurs shed much light on their feeding habits. Some dinosaurs like *Ornithomimus* ("bird mimic") were actually toothless and they may have fed upon crustaceans. Those that fed exclusively on flesh were provided with sharp, dagger-like teeth, some of which were smooth on the borders, others serrated.

As among many living reptiles new teeth were grown to replace those broken or lost throughout the life of the individual. The plant-feeding Horned dinosaurs shed their teeth and replaced them with new ones as soon as the enamel-surfaced crowns wore off.

Two thousand teeth

In other groups like the plant-eating Duck-billed dinosaurs, the feeding habits were evidently quite different, since they were provided with a highly complicated tooth system. Some of them had more than 2000 teeth at a time, arranged in the jaws like rows of cartridges in a gun-clip. The teeth were all curved and had enamel only on the outside of the upper teeth and the inside of the lower teeth. Thus the enameled surfaces acted as the blades in a pair of scissors for sectioning the food. As the enameled surface wore down, new teeth came into place at the cutting edge, and the worn roots functioned as a grinding surface. This complicated tooth arrangement must have served a specific purpose, and it seems probable that these animals fed on some highly siliceous kind of plant like "horsetail" rushes, which were abundant during the Cretaceous period.

We marvel at the comparatively small brain in all of these huge creatures. Some of the largest bodied sauropods had the smallest brains, and none could have exceeded ten ounces in content—only about one-fourth the size of a man's.

Casts of the brain cavity have been made from several kinds of dinosaur skulls. Even the semicircular canals, the "balancing organs," have been determined, and in a few cases we have explored the pituitary cavities. It seems probable that dinosaurs as a race were hyperpituitary cases. This, in a measure, may account for their great diversity in form and sizes.

The brain cast of *Tyrannosaurus rex,* "tyrant king," the largest land-living, flesh-eating creature that has ever lived, shows a well-developed fore and hind brain and abnormally large olfactory lobes. This would indicate that some of the carnivorous dinosaurs at least, depended largely on their sense of smell when searching for food, and that they were carrion feeders as well as killers.

Dinosaurs were more plastic than any group of living or extinct creatures of which we have a definite record, and their capacity to meet changing conditions may account in part for their long existence. Most lizards of today can regenerate a new tail if they lose the original one—but there will be no bone in this replacement. The long-tailed sauropod dinosaurs, however, could regenerate not only the soft tissue of the tail but the tail bones as well. One of the sauropod specimens found in the Howe Quarry at Shell, Wyoming, demonstrates this ability, for 21 vertebrae at the end of the tail were "replacements." Several other similar examples of regeneration were found in this quarry.

What happened to the dinosaurs?

Dinosaur remains are found practically over the entire world, but these animals did not get up and travel from one section to another as mammals do when seeking a change of environment. We picture their migration as a slow, gradual dispersal and encroachment into favorable bordering regions—a movement comparable to wavelets where a stone has been thrown into a pond.

The dinosaur race perished all over the world at approximately the same time, near the close of the Cretaceous period. There has been much speculation as to the cause of their extinction, and several untenable theories have been advanced:

1. It has been suggested that a series of sudden cataclysms such as volcanic outbursts may have exterminated them. But many of the latest survivors died too far from volcanic regions for vapors or even wind-borne ashes to have harmed them.

2. Another supposition is that mammals—progressive newcomers on the earth—might have destroyed the eggs of the dinosaurs. But many kinds of water-living dinosaurs undoubtedly gave birth to living young and were safe from predatory land creatures.

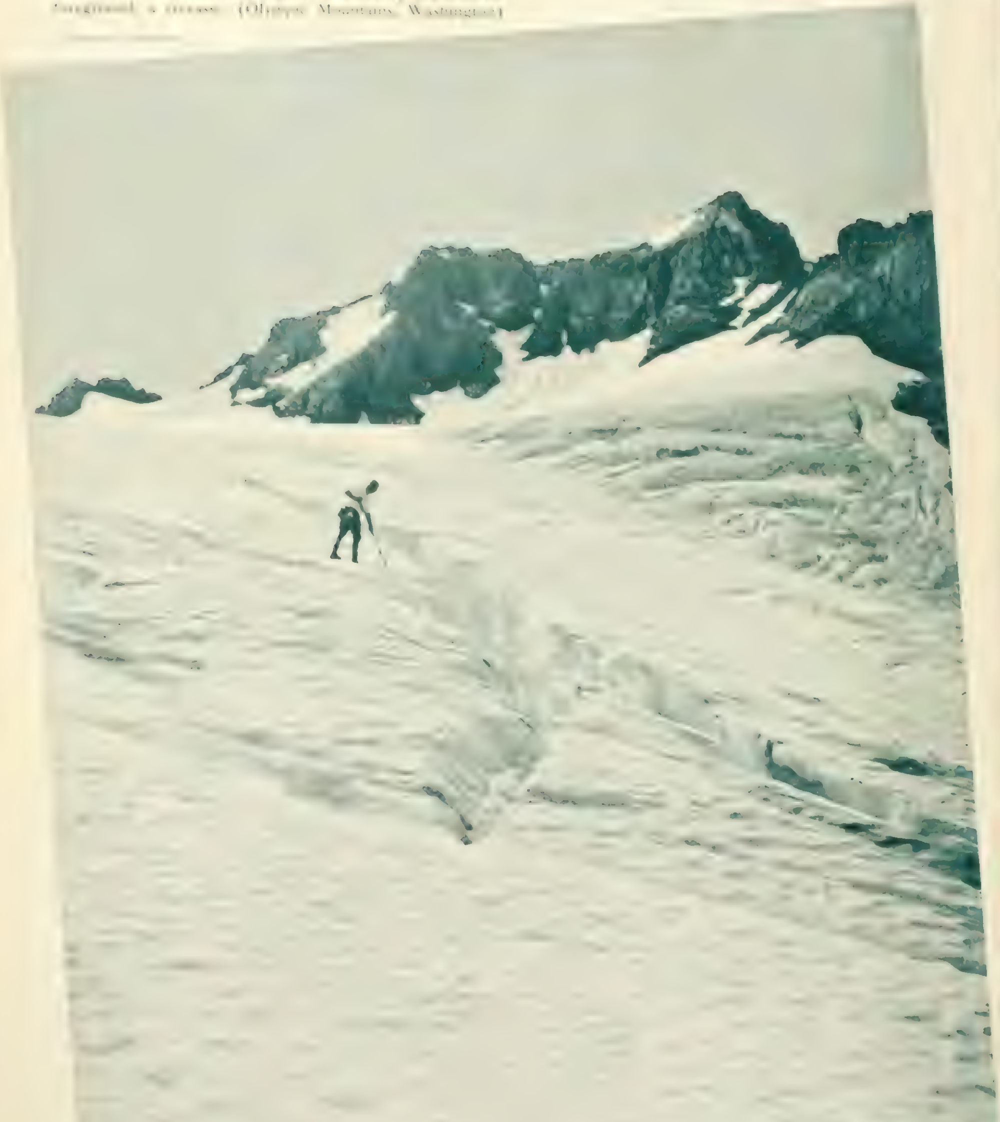
3. Finally it has been argued, that the climate became too hot for the dinosaurs. Modern reptiles, to be sure, cannot stand extremes of heat,—but the plant life at the time of the last dinosaurs does not indicate such temperatures.

The best explanation of the extinction of the dinosaurs follows other reasoning. Dinosaurs had become highly specialized creatures. The plant-eaters were restricted in their feeding habits to certain types of vegetation. When, through regional elevation toward the close of the Cretaceous period, lakes and swamps were drained and plant life changed or became scarce, plant-eaters died out locally, and the carnivores went with them. For they could not migrate rapidly enough to new, favorable places or adapt themselves to a radically and rapidly changing environment.

After all, why should we criticize any group of animals for giving the earth over to other creatures after 140 million years of supremacy? They were amazing creatures, to say the least, and the mysteries still surrounding them will continue to give zest to one of the most absorbing branches of scientific exploration for many years to come.

Glaciers are becoming increasingly important in the study of our changing climate, and "glacier hunting" is a popular sport yielding valuable information. In the background, an icefall is formed where the "crumbled ice" pours over a steep slope; in the foreground, a crevasse. (Olympic Mountains, Washington)

WE LIVE



IN AN ICE AGE

By WELDON F. HEALD

Five new glaciers have been discovered in California, where no ice existed when the big trees were young. Will continental glaciers one day bury our civilization a mile deep in moving ice, or will existing glaciers melt to flood all our coastal cities under 164 feet of water?

Drawings by RAY DE LUCIA

THE glacial period is still with us. One-ninth of the world's land surface is covered with moving mantles of ice, from a few hundred to several thousand feet thick. Today more than six million square miles of ice are actively grinding, scouring, and carving the surface of the earth.

Of course, this is less than half the amount of ice 25,000 years ago at the height of the last great glaciation. But Nature's air-cooling system continues to function. It is only a little less efficient than it was in those far-off frigid days.

We are living during an unusual time in the earth's history. Our present weather is stormier, colder, and more violent, than normal. Fossil records left in the rocks from past ages show that there have been long periods of mild climate, lasting millions of years. It is the usual thing. But these uncounted eons of genial warmth have been broken occasionally by relatively short ice ages when the climate was even colder than it is today. At least four times the world has been overwhelmed by huge continental glaciers. The first ice age of which we have any record occurred in the Huronian period, a billion years ago. The latest, in the Pleistocene, happened so recently that no one can be certain that it is over.

So these are soul-stirring times—not only politically but geologically as well. Perhaps the excesses of one are caused by the other. Such cold interludes are probably trial periods during which all life makes rapid advances, only to sink back into sloth and extinction when the whole world once more becomes a steaming hothouse comparable to the African Congo today.

Man is a child of the ice age. His rise to dominance has occurred during a time of vigorous climate. We are all intimately, though mysteriously connected with the coming of the ice, and we may go the way of the dinosaurs when the last glacier melts some thousands of years hence.

If glaciers are so important to us, so closely related to our revolutionary advance, we ought to know something about them. Where are they? What causes them? Are they increasing or retreating? If we lived in Switzerland or Norway the answers would be easy. Glaciers would be familiar daily sights. But to most of us in the United States glaciers, icecaps, and permanent snow fields are thousands of miles distant.

Glaciers hold secrets which cannot be solved in a lifetime. Although they have been studied for over 100 years, even today experts are not in complete agreement about the mechanics of moving ice. Enough heat has been generated in scientific arguments on the subject to melt several polar icecaps.

The same natural laws govern all glaciers,—from continental ice sheets thousands of square miles in extent to pygmy glacierets covering a few acres. In the United States, glaciers are limited to the high mountain ranges of the West. They are mostly small, wasted remnants of once magnificent ice streams, but they show in miniature all the characteristics of moving ice bodies.

There remain many unsolved problems about the movement of ice, but the fact that it does move furnishes us with the best definition of a glacier: a permanent reservoir of snow, replenished each winter and drained by a slow, continuous movement of its compacted snow and ice to lower elevations.

Glaciers form wherever more snow falls each winter than is melted away the following summer. Let us take an example: a high mountain peak in a snowy region. Winter storms pile snow on this peak while blizzard gales whip it into huge, curling drifts. The summer sun melts most of the snow, but perhaps the largest drift lingers through the autumn as a foundation for the succeeding winter's storms. So each year more snow is added to the accumulations left over from preceding winters. If the snowfall remains relatively constant the drift annually becomes deeper and covers a larger area.

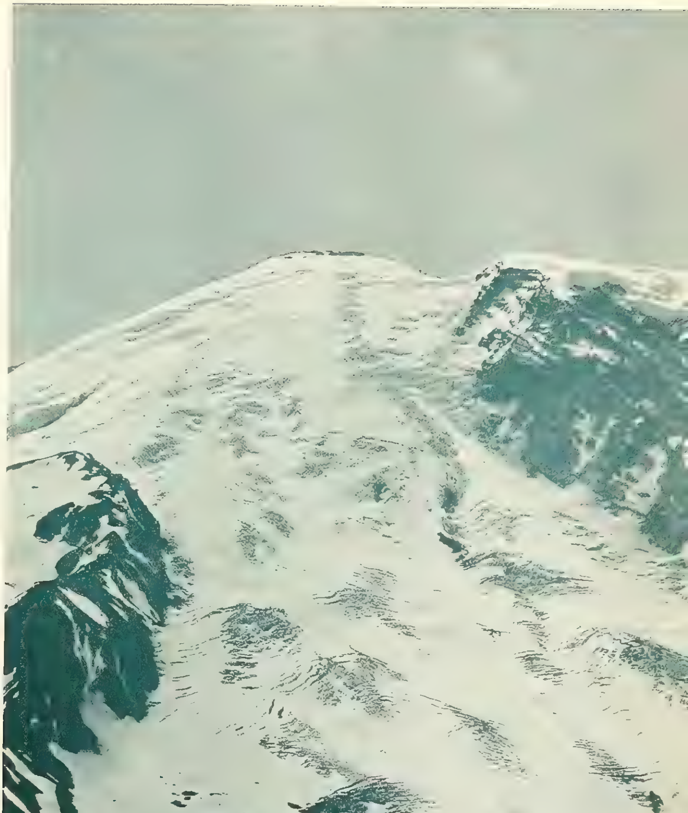
Through repeated thawing and freezing the drift turns into granular snow called *névé* (pronounced nay-vay′). This word, like most terms relating to glaciers, is borrowed from the French.

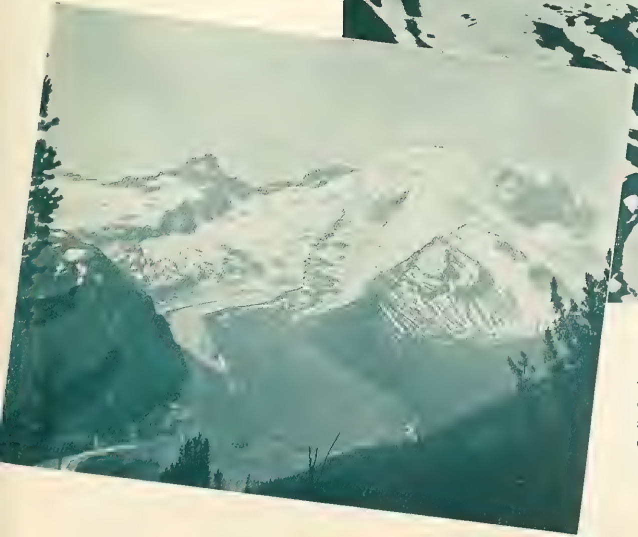
As our snowdrift deepens year after year its weight becomes so great as to compress the older layers on the bottom into ice having a crystalline structure. This is the critical point when a snow field becomes a glacier, because névé by itself does not move continuously, while crystalline ice does. Scientists have puzzled for many years over Nature's snow-into-ice conjuring trick. They haven't

At left, A MOUNTAINEERING PARTY can be seen exploring a remote glacier in California's Sierra Nevadas, one of five new glaciers discovered by the Sierra Club three years ago. The large crack above the climbers is called a *bergschrund*, a feature formed where moving ice pulls away from the snow field above.

GLACIERS form when more snow falls each winter than is melted away each summer. Sholes Glacier, at right, is in the only region on earth where winter snowfall is so heavy that glaciers form wholly below tree line—our Pacific Northwest.

(Right) THE "RIFFLES" in this vast surface of ice can be likened to the rapids in a stream: they reveal rough places in the bed of the glacier. This is the upper four miles of Winthrop Glacier, one of 27 rivers of ice that pour down the sides of mighty Mount Rainier





(Left) EMMONS GLACIER, the largest in the United States. Its lower third is covered with piles of rock, called moraines. These deposits, excavated by the moving ice, enable geologists to map the location of glaciers which vanished ages ago

[illegible]

[illegible] motion. How thick it must become in order to "flow" [illegible] given, but it probably depends somewhat upon the [illegible]

[illegible] cally and relentlessly down the mountainside a few inches or a few feet a day. It obeys the laws of moving liquids: conforming to its bed, rounding corners, churning past obstructions, and pouring over cliffs [illegible]

Although the glacier as a whole acts like a moving fluid, the ice itself retains all its well-known ice-like characteristics. It is brittle, easily split,—but broken parts have the ability to freeze together again and may even be remolded into different shapes under melting and pressure. Therefore our glacier's surface is rent, riven, and cracked where it passes over a [illegible]

River of ice

We begin to see how much a glacier resembles a river. Hundreds of *crevasses*, or deep cracks, break the surface into frozen riffles and rapids. Areas of tossed and broken ice splinters, called *séracs*, pour over the steep places like waterfalls. Smooth stretches [illegible] ponds.

But our glacier is like a river in other ways. It moves more rapidly in the center than at the sides, faster at top than at the bottom. It flows continuously from the névé field at its head. Our ice river can no more separate itself from this source than a stream of water can desert its spring. Like a river the glacier is dependent upon a constant supply—when that ceases, it dies.

If the snowfall on our mountain peak remains about the same, a point is eventually reached at a warmer, lower elevation where the descending ice melts away each summer as rapidly as winter snow replenishes the névé reservoir. Here is the glacier's terminal or "snout." A good sized stream of melt water drains it, usually issuing from an arch in the ice. The water is milky because of glacial silt in suspension. This pulverized "rock-flour" is an indication that the glacier is actively grinding, scouring, and shaping the bed over which it passes.

The terminal will remain at the same point as long as the supply of new snow at the head equals the melting at the foot. When the climate becomes cooler or the snowfall heavier, the glacier will continue to advance down the valley to still lower elevations, possibly combining with other glaciers to bury the land in a new ice age. When the weather moderates or the snowfall lessens, the front of the glacier will retreat toward its head, perhaps eventually melting away completely. The size of our glacier is deter- [illegible] snow supply and summer melting.

[illegible] feet thick. It can be imagined what revolutionary changes these ponderous masses weighing millions of tons cause as they move over the landscape. It is be- [illegible] ing, leveling, and excavating that the former extent [illegible] walled mountain basins, or *cirques*, usually containing chains of lakes; U-shaped valleys, often descending in giant steps; scratched and polished rock; scoured and leveled land stripped of all soil.

[illegible] valleys, they carry down enormous quantities of rock, which they dump at the terminals. If a glacier terminal remains for some time at the same place, rock piles accumulate around the end and sides of the lower tongue. These terminal and lateral *moraines*, sometimes several hundred feet high, are left when the ice finally retreats. They show us the exact outline as well as the former extent of the glacier that made them.

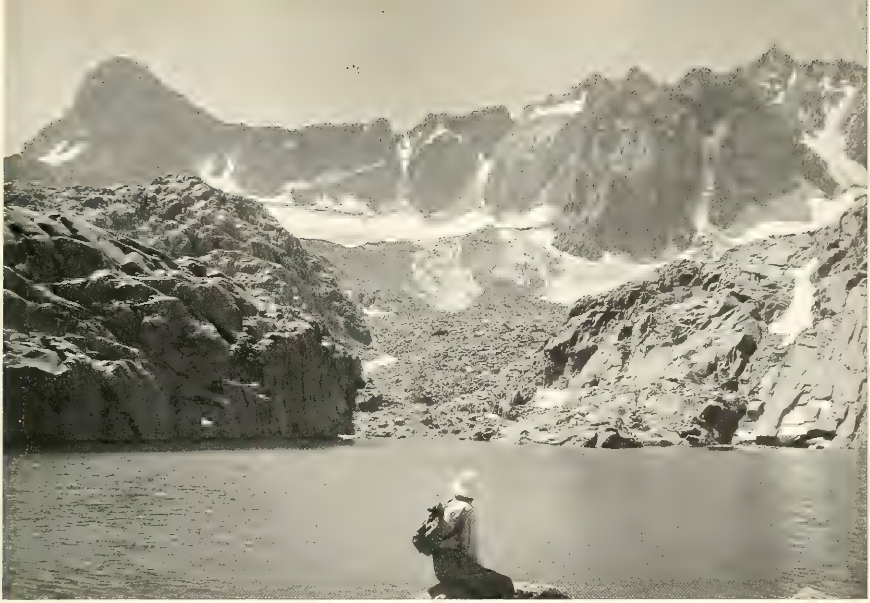
From a study of moraines, cirques, scratches, and polished rock, accurate maps of former glaciers can be made in regions where there is now no ice. Artists are enabled to paint pictures of ice-burdened mountains and valleys as they actually appeared thousands of years ago. Such things stir our imaginations. They help us not only to visualize a familiar landscape as it was in past ages but also to understand why it looks as it does now.

Glaciers in retreat

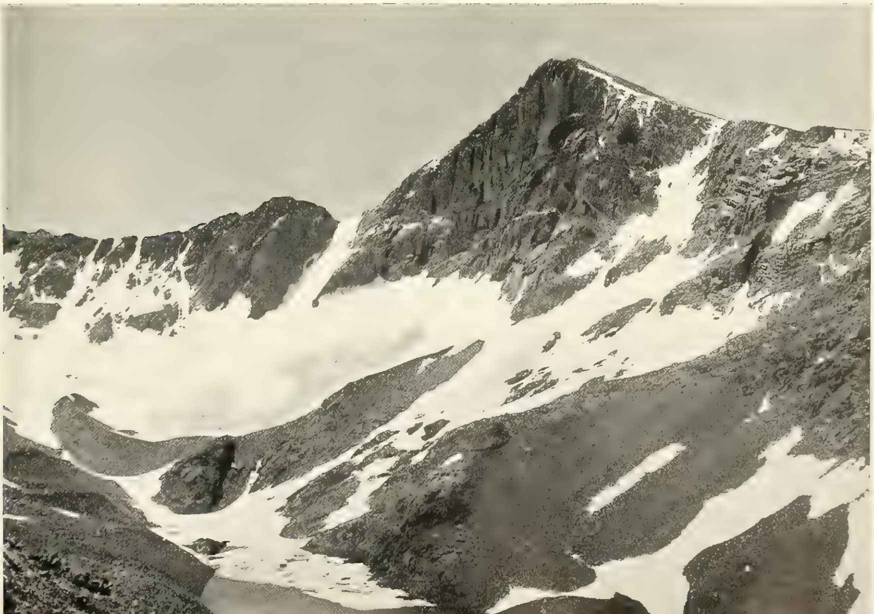
On the whole the glaciers of the world are in retreat today, those of North America-perhaps fastest of all. In sections of our West the retreat has become almost a rout. Many smaller glaciers have lately disappeared completely, while others have so wasted and shrunk as to be almost unrecognizable from photographs taken 20 years ago. If Nature doesn't rush fresh reserves of snow and cold to the glacier front, the ice battle will be lost. The glacial period in the United States will soon be a thing of the past.

In recent years the National Park and Forest Services together with western mountaineering clubs have been systematically recording data about our remaining glaciers. They take annual measurements, make surveys, collect photographs, and write yearly reports. The results are sent to the International Committee on Snow and Glaciers whose Washington branch, headed by the eminent geologist, François E. Matthes, is a section of the American Geophysical Union. The Committee welcomes additional information from whatever source and is glad to receive photographs and descriptions of glaciers from individuals. Every little bit helps, for ten questions [illegible] spring up for every definite answer.

The Sierra Club of California is taking a census of glaciers in the Sierra Nevada. Glacier hunting has become a popular sport on summer mountain trips. In 1939, five hitherto unknown or unreported glaciers were added to the list. The ice bodies of the Sierra are small, but it is their smallness which makes



ATTENTION FOCUSES on the Sierra Nevadas of California as a region offering much insight into climatic changes. Above is seen the largest glacier in that area, beautiful Palisade Glacier, covering several square miles in the protecting shade of 14,000-foot peaks. The ice tongue reaches nearly to the lake but is buried under rocks excavated from the headwall. California had no glaciers 4000 years ago, when over half a million cubic miles of ice now frozen in the world's glaciers lay melted in the sea. But California's glaciers are barely holding their own. Like Dana Glacier below, many of our western "glacierets" hang in the balance between moving ice and stagnant snow. Which way they turn may indicate whether we are leaving the Ice Age or entering a new one



[illegible]

[illegible] continuous period of refrigeration. There were four [illegible] curred 700,000 years ago. The fourth is not over yet. We are in a cool spell today—a sort of "little ice age."

[illegible]

The glaciers of the Sierra Nevada have proved especially helpful in checking and plotting these variations in climate since the last ice maximum. François Matthes was the first to realize that the present-day California glaciers are not remnants of Pleistocene glaciation. Those huge ice streams melted away completely about 4000 years ago. Mr. Matthes pointed out that the raw, new moraines of the present glaciers, many of them containing stagnant ice, have no connection with the larger moraines some miles down the valleys, which are obviously several thousand years old. This led to the theory that there has been a recent resurgence of glaciation on a small scale.

The related observations brilliantly check Mr. Matthes' deductions. Owens Lake, a desert body of water without outlet, on the east side of the Sierra, was tested for the amount of salinity or mineral salts it contained. It was found that the present salt content would take roughly 4000 years to collect. Borings showed that the lake inherits no salinity from the much larger Pleistocene body of water, since those ancient salts are buried under sediments on the modern lake floor. Therefore, there must have been [illegible] the time when Owens Lake dried up. This was the period when all glaciers disappeared from the Sierra, for today they are much too small to withstand any further warming or drying of the climate. Correlations like this make a scientist's life worth while.

But the neatest independent corroboration of Mr. Matthes' theory is brought to light by a study of ocean levels during past glacial stages. The amount of ice now covering the land is equivalent to about [illegible] the volume of ice at its maximum was enough to [illegible] level.

[illegible]

Did they leave any record at that level? Fortunately, Hawaii, Samoa, and other volcanic islands of the Pacific rise from an ocean floor which has probably remained stable for millions of years. Ancient sea levels can plainly be seen on these islands. [illegible] and the succeeding period exactly checks with land observations made in glaciated regions. The lowest level, now over 200 below the sea, made during the maximum glaciation, comes within a few feet of Daly's mathematical estimate, of the amount of water removed from the ocean and locked in the ice fields.

Since then there have been several fluctuations above and below the present sea level. But the most [illegible] fossils to be about 4000 years old. Does it corroborate Mr. Matthes' theory about Sierra glaciers? It does absolutely! The ocean at that time was 25 feet higher than it is now. This means that 4000 years ago there were 655,000 cubic miles of water in the ocean that are now locked on land in the form of glacial ice. Since Sierra glaciers are now barely holding their own, we can be certain that there was no ice in California 4000 years ago, which is not so great a time when we realize that trees living then survive today.

Ocean levels, glacier observations, and climate all tell us that we are living in an ice age. In the western United States, Mount Rainier, Baker, and other high peaks of the Pacific Northwest still carry huge, sprawling rivers of ice; the Olympic and Cascade Mountains glisten with hundreds of ice fields; the Rockies and Sierra Nevada yet shelter numerous glaciers.

Is the ice age drawing to a close? Will our climate continue to moderate until palm trees grow on Alaska's shores? Or is it possible that continental glaciers will descend upon us once more, burying our civilization a mile deep in moving ice? The odds are even. No one knows what causes an ice age nor what makes it disappear. It is a good bet either way. But the chances are that you will not be here to collect on that distant, future day when *your* guess turns out to be correct.

THE RISE OF THE DINOSAURS

(Continued from page 2[illegible])

the animal is still 75 feet long. A unique feature of this dinosaur is that his front limbs are longer than his hind ones, which together with a terrifically long neck made it possible for him to nibble comfortably at leaves 40 feet above the soles of his feet!

A large number of other well-known sauropods living at that time were all thoroughly overspecialized for an aquatic or semiaquatic life in humid climates. Nearly all of them died out at the close of the Jurassic, when earth movements drained their lakes and marshes and the climate became more arid. Survival was possible only for those few lucky ones that lived where the old conditions prevailed. They continued on into the next geologic period, and a few managed to survive to the very end of it, when all dinosaurs gave up the ghost.

The plant-eating dinosaurs that dwelt on land in Jurassic times were the descendants of the earlier ornithischian group already mentioned, which now became more important. There are four main branches of these: the High-armored, the Low-armored, the Horned, and the Duck-billed dinosaurs. The Family Tree on pages 288 and 289 shows when they evolved and how they are related. They were rare at the beginning of this period but branched out considerably towards the end.

The Duck-billed dinosaurs, quite obviously, had bony duck-like snouts. Some of these dinosaurs, especially the later ones, got to be very large. They all walked on the toes of their hind feet, although certain ones occasionally touched the ground with their hands. The whole skeleton of these animals was massive. The head was relatively large and was equipped with numerous teeth of the chopping type. *Camptosaurus* was the most common and widespread representative of the Duck-billed group at the end of the Jurassic.

The High-armored dinosaurs or Stegosauria got away to a good start at the very beginning of the Jurassic and became a typical feature of the landscape during this time in the earth's history. The earliest one we know, *Scelidosaurus*, had several rows of tubercles and keeled plates along the back, and a row of fairly large vertical plates down along the top of the tail. But his coat of mail wasn't nearly as fancy as that of his descendants, who really went in for decorations. The stegosaurian style-setter was *Stegosaurus* himself, typical of North America late in this period and of occasional occurrence in England.

Stegosaurus got to be 30 feet long, had a little head and a short tail. That little head of his had very little in it, but like the sauropods, he had a second "brain" in his hindquarters—and what a "brain"! In some it was 20 times larger than the regular brain up forward.

A double row of large plates projected along the middle of the back and onto the tail, at the end of which rose two pairs of long spike-like spines. Of what service these ornaments were to the animal is not certain. Many suggestions have been made. It has even been proposed that they might have acted as a sort of roofing or self-invented shade to protect the reptile from too much sunlight when forced out of the abundant vegetation. They certainly were a protection against attack when dictator *Allosaurus* and his crew took on *Stegosaurus*. And the spines at the end of the tail must have been very effective ankle-busters in combat. Gaudy and homely as these structures seem to us, we may assume that they were attractive to a stegosaurette back in the Jurassic jungles. Furthermore, it must have taken a shrewd Meat-eater to spot one of these creatures with its big, and probably greenish, leaf-like superstructure, half-hidden in one of those Jurassic marshes or in the bush along one of the lakes.

By the end of the Jurassic period, the dinosaurs had risen to unquestionable ascendancy. But the Age of Reptiles was not yet over, and with further environmental changes in store for them, the dinosaurs were destined to have an even greater evolutionary development. With the closing of the period, the earth once again began to tremble. And in their effort to meet new environmental conditions, these most sensational animals of all time entered upon some of their most surprising adventures in the remaining 60 million years of the Age of Reptiles.

Be sure to read "The Last Dinosaurs," by Barnum Brown, beginning on page 290.

For use in schools and colleges, a set of 30 Kodachrome color slides on Digging up the Dinosaurs is now available, complete with descriptive commentary. Prepared by the Department of Education at the American Museum of Natural History, this set embodies the best and latest information on the dinosaurs, showing many of the unique exhibits at this museum. The set is priced at $18.00 and is suitable for use in projectors taking the increasingly popular 2 x 2 inch slides.

Sirs:

[illegible] Natural History [illegible] Natural History Magazine [illegible]

[illegible] Jr.

P. S. I am [illegible] years old

[illegible]

Sirs:

[illegible] Lutz . . . John D. H[illegible]

[illegible]

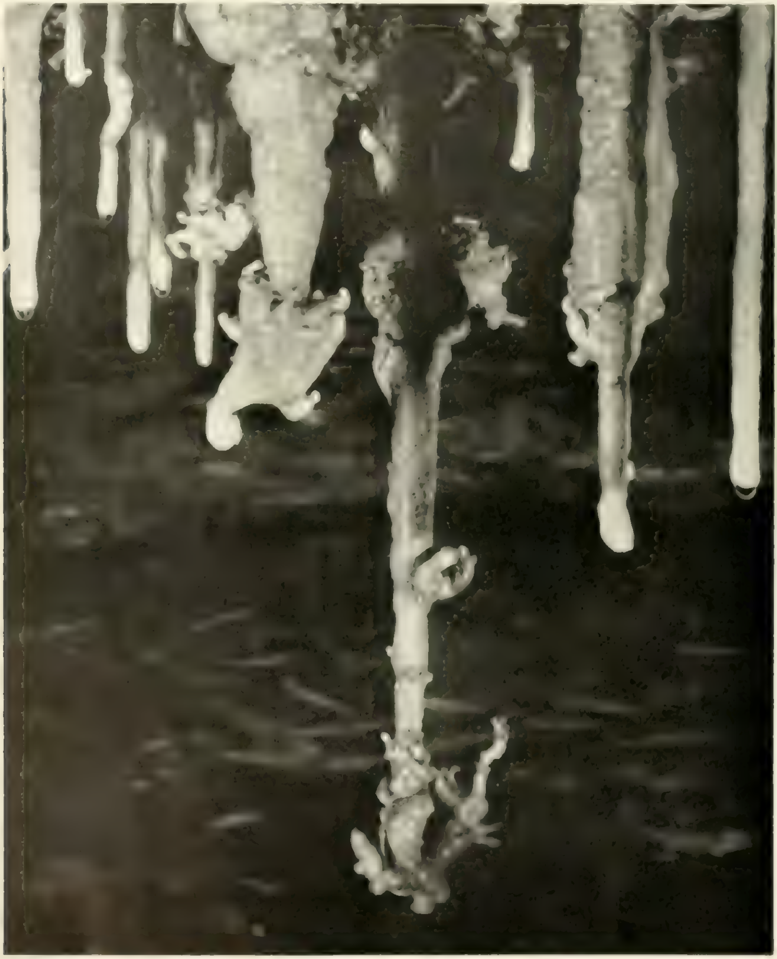
Sirs: ° ° °

[illegible] Mountain [illegible] Blank . . .

[illegible] Magazine [illegible]

[illegible] American Museum of Natural History [illegible] Museum [illegible] Natural History [illegible]

R[illegible] Roy



SIRS:

. . . The Magazine makes a splendid Christmas present—thank you.

Troy, N. Y. E. W. GOULD.

* * *

SIRS:

. . . The October issue of NATURAL HISTORY arrived Friday. You should see the waiting list. It grows and grows. I have one fellow who is copying that chart, "Grandfather Fish and His Descendants," onto a big sheet of paper so that he can have his own copy of it. No. 3395.

In a New York prison.

SIRS:

. . . I have secured four members during the past year, each of whom feels that I have done him a favor . . . NATURAL HISTORY is the one magazine that I literally read from cover to cover.

San Diego, Calif. H. K. RAYMENTON.

* * *

SIRS:

I have just finished reading Doctor Romer's very interesting article on "The First Land Animals." In his discussion of the egg-laying habits of the amphibians he makes the statement that "all amphibians must return to the water to lay and fertilize their eggs."

On page 35, Part II of Schuchert and Dunbar's new edition of *Textbook of Geology,* a similar statement is made. "The amphibians were never able to improve on this habit and so, throughout the ages have returned annually to the water to spawn."

A year ago our class at the University of Michigan Biological Station collected the eggs of the salamander *Plethodon cinereus* on land! After checking in the late Doctor Noble's *Biology of the Amphibia,* I find no mention of their

Continued on page 312

SIRS:

Since their formation is something of a riddle, I thought your readers might be interested in these highly irregular stalactites called helictites. They are formed of the same material as the more familiar stalactites and stalagmites—carbonate of lime—, and their rate of growth is thought to be about the same, perhaps one cubic inch a century.

As for their habit of twisting and turning in every imaginable shape, all that can definitely be said is that certain factors are *not* the cause, such as wind currents, faster or slower flows of water, seasonal changes, or grains of sand or silt in the fluid forming them. It has even been a question whether they grow at the free end or at the base. Lyman C. Huff of the University of Chicago, who has produced artificial helictites, states that the ones in his experiments grew at the free end. He also concludes that, if natural helictites are formed in the same way as artificial ones, they assume their crooked shape as a result of the chance orientation of the crystals at the growing end.*

The photographs shown here were taken in Wyandotte Cave, Indiana, one of whose passageways is said to contain more of these curious helictites than any other known cave avenue in the world.

Evansville, Ind. GEORGE F. JACKSON.

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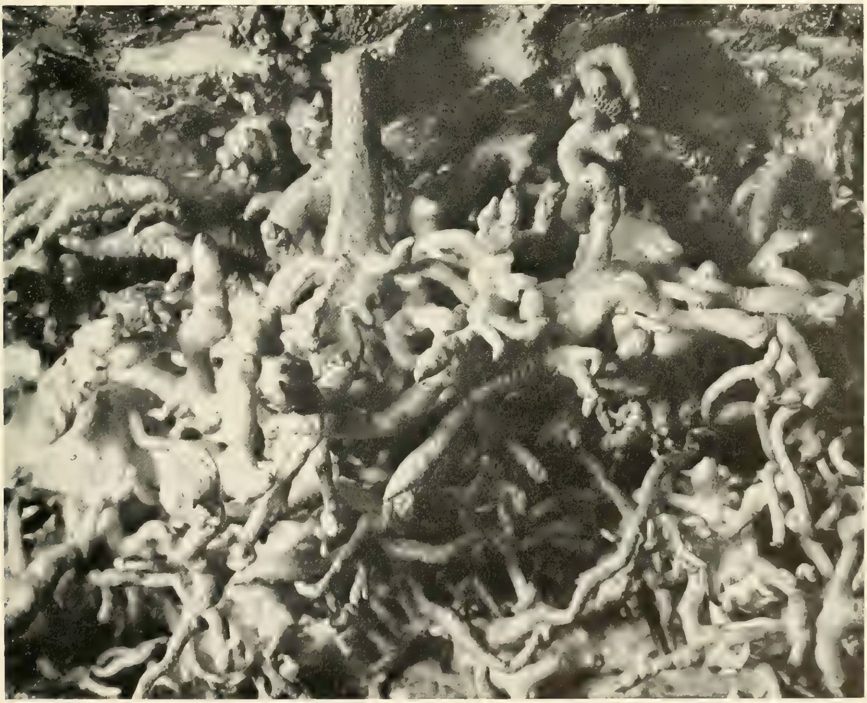
* In the *Journal of Geology,* August-September, 1940.



WINTER COLORS IN KODACHROME

By CHARLES H. COLES

[illegible]

[illegible]

WATCH YOUR EXPOSURE IN WINTER [illegible] meter [illegible] serve you well only if [illegible] photographic judgment

K[illegible] snow. Of course Winter [illegible] the color camera. The brilliance of freshly [illegible] faithfully with color film.

A snow scene in color can be a simple or a difficult subject, depending upon the contrasts of light and dark. Usually the scenes most easily recorded are those in which the contrast between the lightest and the darkest parts of the picture is comparatively small. The tonal scale that the color film is capable of rendering properly is limited, and this presents diffi[illegible]

Direction of Light

B[illegible] light, the photographer can often control the contrast in his snow picture. Ordinarily, when no snow is on the ground, the lowest contrast is usually obtained by working with the sun behind the camera, its rays falling directly upon the subject. Any shadows that are cast by the objects in the picture fall behind the objects them[illegible] film must include only the brightness range of the objects themselves; it does not have to pick up detail in the shadows.

But with snow on the ground, the shadows reflect so much light from the sky that they are sufficiently bright to come within the exposure range of Kodachrome. Since they are illuminated by light from the blue sky, they turn out a bright blue in the finished color picture. That the shadows are actually blue in color is not generally noticed but if they are observed carefully this fact will be substantiated.

In taking winter sports scenes the Kodachrome-user is beset with the problem of contrast between the dark togs and the white background. More exposure will brighten up the person's face, the snow, and the sky to the point of overexposure. Better results are obtained by selecting skiers, for example, with lighter colored outfits, but the best skiers unfortunately seem to wear the dark suits. In commercial advertisements, you will notice, skiers do not wear dark blue suits. Dark garments are conspicuously absent; bright mittens, caps, and jackets enliven the picture.

The bright surface of sunlit snow presents a practically uniform reflection of white light when the sun is behind the photographer. But by turning so the sun is at one side or the other, the photographer will catch the surface texture and waves that relieve the monotony.

Some of the finest pictures of snow have been made with back lighting, i.e., with the sun directly in front of the photographer. With this light direction, the crystalline surface of the snow literally sparkles in the picture. Shadows of small branches and rocks will add interest to the scene.

However, back-lighted pictures are by no means easy to take, because it is difficult to prevent the sun from shining directly into the lens. If the sun's rays as much as touch the lens, streaks and flares will practically ruin the picture. Two ways are open to the picture-maker to circumvent this problem. A deep lens shade may prevent the rays from entering the lens, though if the sun is fairly low, this will usually prove ineffectual. It is then a good idea to ask someone to hold his hat about four feet in front of the camera in such a way as to prevent the sun from shining into the lens. But keep the hat out of the picture!

Perhaps a better way of shielding the lens is by finding a tree with an overhanging branch to frame the view you are photographing. An evergreen makes an effective frame. The sun, concealed behind the tree, will no longer shine into the lens, and the picture will be improved by the dark border.

Exposure

Exposure meters of all kinds are notoriously inaccurate on all bright landscapes. And with snow, the meters are even less reliable. Photoelectric meters usually indicate woefully short exposures for views in which snow is prominent.

The reason that the photoelectric meter goes so far wrong on snow is not difficult to understand. The trouble is in the basic assumption that all subjects have an equal amount of light and dark, and that the average of the light reflected from a scene is the same as that from an object of average brightness. Snow is by no means a reflector of average brightness. If the exposure meter were read on the snow and the indicated exposure given, the snow would be reduced to the brightness of this theoretical average—a rather dark tone. In Kodachrome the snow would turn out a dingy purplish blue. More exposure is obviously needed.

Kodachrome is limited to a brightness range of about four to one if good color is to be obtained. In other words, the brightest object should not reflect more than four times as much light as the darkest object. Therefore, we want snow to record at the upper end of our brightness range, because nothing else in the picture will be brighter. To accomplish this, all we have to do is to point the meter directly at the snow and read our exposure. The camera should then be set one stop larger than the meter reads. A more convenient way is to set the film speed dial to half the film speed figure and take the reading on the snow directly. Kodachrome has a Weston speed of eight for the outdoor film; so the meter is set for a film speed of four and readings made directly on the snow.

Filters

Under normal conditions, no filters are required when taking pictures on a sunny day. Kodachromes made in the shade on such a day, however, will come out far too blue to look well. A Wratten 2A filter will correct this blueness with no loss in speed. This filter will also improve pictures made in cloudy weather.

With these few not too complicated techniques in mind, the color fan may ride his hobby even when the snow falls. He will find his winter Kodachromes as full of sparkle as the pale greens of spring, the brilliant hues of summer, and the russet of fall foliage.

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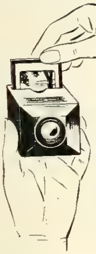

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Father of the Dinosaurs

Barnum Brown is today widely acknowledged the number one dinosaur hunter of the world and the greatest authority on their life and times. Yet hardly any form of organic life, living or dead, has been neglected in his 50 years of exploration all over the world. Diplomat, oil geologist, and scientist, his career is one of the most fascinating in the annals of the American Museum

By D. R. Barton

W[illegible] the connection between the sauropods [illegible] R[illegible]fining Company. For a number of [illegible] stations have received free booklets [illegible] history and development of the dinosaurs in surprisingly entertaining fashion, without sacrifice of accuracy.

Responsibility for the accuracy and partial responsibility for the whole scheme lies with Dr. Barnum Brown, Curator of Fossil Reptiles in the American Museum. Through these pamphlets which he edited and wrote he has answered the questions of millions of children and adults throughout the country, becoming as it were the much honored and sought-after Mr. Bones of the dinosaur show. The first issue consisted of a run of 24 million stamps. They were gobbled up in 48 hours. There followed a printing of 72 million more all of which have now been distributed. Indeed, except for a few of the larger cities, the booklets are in standard use throughout the country as secondary and elementary school texts in fossil reptiles. This [illegible] dimension that no other naturalist can well boast of its equal.* And millions have been added through the current showing of Walt Disney's *Fantasia*, in the making of which Doctor Brown was a consulting specialist. Yet, though his written word and directing influence have spread far and wide, he has kept himself very much in the background. This is largely because dinosaurs and their contemporaries are the moving passions of his life, and [illegible] of their recovery, restoration, and interpretation to the end that they may contribute to the general knowledge of life on earth. The 200 specimens on exhibition in the American Museum and the countless others awaiting assembly in the laboratory are almost all in some measure the fruit of his labors. He calls them lovingly his children, and in his own eyes at least they all have the vivid color and movement of actual living creatures.

Barnum Brown

The Man

Considering the difficulties of securing the specimens and their analysis, it is probable that no other department of the Museum has made such tremendous strides as has Fossil Reptiles under Brown's leadership. When he first came to the Museum in 1897, fossil reptile bones were considered of little "osteological importance" by many of the officials, largely mammal [illegible] It is a fact that the [illegible] in sufficient number to work them out on a systematized, zoological pattern was beyond the realm of possibility. Brown's record of the last 45 years has all gone to prove that they were mistaken. He went out into the field and showed that the bones *could* be gotten, that by patient application they could be gotten in sufficient numbers, and finally that they could be systematized. From the mere handful that had been described up to the 1890's the number of dinosaur species has now risen to approximately 5000, many of which resulted directly or indirectly from Brown's expeditions. He has worked in nearly every major geographical area except Australia, Japan and the South Sea Islands. He has been to Europe both in a diplomatic capacity and as an explorer, and has used all forms of transportation (except the submarine) from human labor to the airplane. Moreover he has perfected and in many cases actually invented many of the modern methods of extracting fossil material from its matrix, and of analyzing it in the laboratory.

Born in Carbondale, Kansas, with a prosaic surname, he owes the distinctive alliteration of his full name to a small brother who was impressed by circus posters for the great P. T. Barnum. It was a provisional choice, but as time went on no one could think of a better one. And it turned out to be a singularly fitting appellation, for though Doctor Brown has never gone to the extremes of his great namesake, he has nevertheless put on one of the greatest animal shows on earth even if all its participants have been dead these 60 million years or more.

Barnum's development was the next thing to a straight line. Before he was much beyond the toddling stage he began a serious collection of fossils which gradually outgrew various rooms in the house and was finally relegated to the laundry building.

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*[illegible]

These fossils were not bones but sea shells. Sea shells in Kansas? Yes. Until about 60 million years ago much of that state lay under the ocean, and before that time parts of it had acquired a layer of coal. Late in the nineteenth century the coal was mined, and during these operations the sea shells appeared.

His parents encouraged him in this absorbing hobby, but they never suspected that he would eventually make a name for himself at essentially similar tasks. When he went to Kansas University, it was with the idea of studying civil engineering; but at the University, Brown met Professor Samuel W. Williston who at that time was one of the big men in paleontology. It was a red-letter day for Brown and a happy occurrence for Williston. The latter was a fine hand at finding and identifying specimens but no great fist of a digger. Conversely, Brown had the patience of Job, doubled and redoubled. A born collector, he quickly became a master of fossil extraction and filled a sizable lack in Williston's professorial life. Their Jack Sprat relationship continued in this symbiotic manner for many years to come.

Early Museum days

When young Barnum arrived in New York in 1897, he had a scholarship to complete his graduate studies at Columbia, and a part-time job with the Museum. Associated with President Osborn, he immediately plunged into expeditionary work of a most ambitious character.

One morning in 1899, Osborn called him into his office at nine o'clock and said, "Brown, can you go to Patagonia with the Princeton party? The boat sails at eleven o'clock and you will probably be away a year and a half."

"That's rather short notice, Professor, but I'll be on that boat," said Brown.

This expedition, accompanied by Brown for the American Museum, explored 800 miles of previously untraveled pampas. Brown was able to gather a large collection of prehistoric mammal skeletons for the Museum, and when at the end of a year the Princetonians had had enough, Barnum was just getting his second wind. With three pack horses he made a solitary tour of Patagonia's bleak Atlantic coast chipping out fossils with his favorite tools—a prospecting pick, crooked awl, and whisk broom. His appetite for bones now whetted to a keen edge, he made up his mind to circumnavigate Tierra del Fuego after finishing work in Patagonia. This was not just for the ride but to see what that dismal island might have to offer the science of paleontology. His hired cutter came to grief, however, when a storm swept into Spaniard Harbor and capsized her.

Brown's experience with the ways of the sea had been chiefly confined to picking up sea shells of the Carboniferous period, and since salt water had retreated from Kansas many millions of years before his birth, he never had the opportunity to learn to swim. No whit daunted, he seized a broken hatch cover and floated to shore while the crew reached the same destination clinging to barrels. The next three weeks were spent in a gold miner's camp, after which a coastal schooner picked them up and carried them around Cape Horn and eventually to France—which was about the last place in which Brown ever expected to wind up an expedition to Patagonia.

This episode, which took place in his twenty-sixth year, reveals two significant characteristics of Barnum Brown's nature: (1) in common with some of history's greatest explorers, he likes to do things his own way—and, whenever feasible, alone; (2) there are few personal risks he is unwilling to take once the scent of a valuable specimen assails his peculiarly sensitive nostrils. Today he is older and wiser, but essentially little changed. At the age of 60 he lost his grip sliding down 40 feet of rope into an extinct volcanic crater in New Mexico and came within an ace of dashing himself to smithereens all because he wanted to see if there were other specimens where the mummified remains of an extinct sloth had been discovered. He did not find other fossils but he did get a pair of hands rasped and battered into mincemeat. In fact his hands always seem to rush in where angels fear to tread. One evening in India, the arrival of a snake raised quite a rumpus about camp, but Brown, thinking instantly of a good herpetology item, snatched up the serpent and discovered only when it was pickled in alcohol that he had been holding a king cobra.

Yet Barnum Brown is no reckless exponent of derring-do, and for a man whom circumstances have drawn into the cauldron of international affairs, his appearace is the most misleading imaginable. Of medium height and weight, his grave, sometimes melancholy countenance might remind one of a Presbyterian divine; but when you note the gold-chained pince-nez and the sparkle of the eyes, you can easily believe that his face may have been the winning of many a poker game. It is not too difficult to believe that he likes to put up his own buffalo berry preserves—which he does. To learn also that he is much in demand as a ballroom dancer well-nigh staggers belief, and certainly goes to show that the surface severity is merely thin veneer. Indeed, "everybody," to quote one of his colleagues, "is crazy about him. When he comes back to a summer digging grounds, local residents meet the train in droves and fight to see who gets him in their car."

Diplomacy

During World War I he was called in by the Treasury Department as an expert geologist to work out defense tax rates for the oil industry. Incidentally, much of the ensuing legislation is expected to be revived in the present emergency.

He resumed the more glamorous exploratory activities in 1923 when he took up fossil-hunting in the eastern Mediterranean during the Greek-Turkish War. Up to this time his career had been hectic, to say the least. He had left the Museum temporarily to accept a geological commission from the Anglo-American Oil Company to determine whether there was any petroleum in Ethiopia. There wasn't. But there were lots of other and — to Brown — more interesting things. By instinct an indefatigable, not to say voracious, collector, he lost no time rifling the kingdom of the Lion of Judah of its least marketable natural wealth. Vertebrate fossils were not especially plentiful, but there was an abundance of the earlier invertebrate variety, together with swarms of insects, lizards, and snakes, all of which were very much alive until Brown got his hands on them. He dispatched the whole job lot to the American Museum wherein they now comprise one of the world's outstanding collections in the invertebrate paleontology, herpetology, and entomology of Ethiopia. There followed the Indian expedition, of which we shall hear more anon, as well as incidental work in Arabia and the Sudan.

[illegible] near. [illegible] Mediterranean.

[illegible] taneously. The oil company wanted [illegible] Mustapha K[illegible] Great Britain openly backed them against the Turkish adversary.

With [illegible] to any natural history items that might come to light along the way, and his mind busy with the problem of properly approaching the redoubtable Mustapha on that oil matter, Barnum Brown made for Ankara, undaunted by a few Turkish shells that geysered uncomfortably close to the American destroyer which had carried him across the Dardanelles. Asked how he fared on this complex mission, Doctor Brown replied that the oil transaction was successfully consummated. And the ammunition leak? "I secured the information they wanted." And did he collect anything for the Museum in Turkey? "No," he said testily, "I couldn't find the time."

Five Years afield

Just before the press of international affairs, however, Brown had accumulated many treasures for science in the course of a junket that kept him from his native land for five long years. Not that this was a leisurely undertaking by any means. Though Brown dislikes hot countries, the exigencies of his profession oblige him to work in them, which he does with tireless energy. And for a good reason. "Playing a lone hand has had disadvantages as well as advantages. I very quickly discovered," he says, "that when I stopped, the whole ex-[illegible]

This human failing he found to hold true all over the world, however much other expeditionary problems [illegible] social customs.

Recollecting his Ethiopian trip, Brown remarks that, "a mule caravan with black servants is like an appetite; it continually grows and is difficult to curb." Nor were the patriarchal potentates any easier to handle. To smooth the way, Brown presented a diamond necklace to the Queen and a diamond wrist watch to the high priest, and an electric light plant for the palace. "On a broiling hot day, in full evening dress, astride small mules, and sheltered by umbrellas, our party proceeded to the palace like a triumphal procession. The streets were thronged with white-clad natives and our attendants cleared the way by brushing them aside with whips. On reaching the palace our gifts were presented with great ceremony, after which we were told that in a few days we would receive the necessary paper that would permit our caravan to travel over the distant country. The days lengthened into two months of patient and ceaseless daily trips and interviews with the authorities until they were compelled to deliver this important permit, which was, of necessity, our first step in the investigation. This document, by the way, is written in Amharac and starts with: 'By the Grace of God I am well—how are you? etc.' Quaint in diction, but, nevertheless, of the utmost importance to us; for on reading it, all villagers supplied our every want and made it possible to travel where otherwise traveling would have been impossible."

Hindustan

On a slope of India's Siwalik Hills it was 115° in the shade when Brown was faced with the task of transporting [illegible] skull weighing 800 pounds each to an oxcart road fourteen miles away. Not even mules were available here. A veritable Ptolemy, Brown directed his Hindu porters to shoulder the immense burdens, and marched them down to the trail. It is a tribute to his generalship that everything arrived safe and sound in New York some months later.

India yielded also the complete specimen of a tortoise which stands four-and-a-half feet high and carried a ton of soup meat when alive. Ardent [illegible] specimen in the Museum, like to think how this ancient titan might turn the tables on the wildlife-slaughtering motorist of today. Try hitting 2500 pounds of turtle and watch the Fords go bye-bye, or, as Brown facetiously remarks, hit 2500 pounds of turtle with a Ford and watch the car turn turtle!

It was in the Siwalik Hills that Mrs. Brown, who has accompanied her husband on many of his more recent expeditions, ran afoul of the Hindu religion. While shopping in the village, she chanced to cross the threshold of a storekeeper during lunch hour. The tradesman instantly jumped up and pushed her out of the shop. Mrs. Brown was unhurt but considerably nonplused and thoroughly angry. She pried her husband away from his fossil of the moment, and aided by an interpreter they lodged a heated protest to the head man of the village, threatening to manhandle the shopkeeper. The head man could only assume that the latter had gone out of his wits—for a Hindu to lay hands on a white woman is, speaking mildly, pretty bad—, but when things were finally straightened out it developed that Mrs. Brown had really given him rather severe provocation. Ignorant of the complex religious taboos of the country, she had inadvertently thrown a female shadow across his lunch, automatically defiling the food. The poor fellow couldn't afford to have his second helping spoiled, too, and accordingly flung discretion to the winds and tossed the substance of the shadow into the street.

Pack rat

However, it is not often that Mrs. Brown gets into a scrape of this sort, and her presence on his expeditions has won for her paleontological consort at least one accolade that would not otherwise have been his. The Divorce Reform League recently named Barnum Brown as one of the five best husbands in America, an honor he shares with such assorted luminaries as the late Lou Gehrig and Franklin Delano Roosevelt.

The morning after he completed his five years' exploration of Africa and the Near and Far East, Brown stepped into the elevator at the ground floor of the Museum. Another curator glanced up from his newspaper, murmured, "'Morning, Brown," and started to resume his perusal of the headlines, then looked up again and said cautiously, "Been away, haven't you?" But this is not unusual in an exploratory institution, where it sometimes seems that only the individual himself could keep track of whether he is coming or going.

Although Barnum Brown is too much of a scientist to care whether he is missed around the Museum, he fervently wishes that more of his colleagues would keep him in mind when they themselves set forth into the field. Though such a trait is rare in a man of his calling, he has a strong personal compunction against killing mammals even for scientific purposes; still, hardly any other department in the Museum has been forgotten during his own collecting expeditions, and there can be little doubt that he has unselfishly sent back more material both in bulk and variety than any other curator in the history of the institution. In his own words, he is a born "pack rat," compelled by the nature of his being to make off with everything he sees pertaining to his extraordinarily large sphere of interest. And this includes the entire visible organic world together with a fair share of the inorganic.

Probably the most important discovery outside his own specialty was made at Folsom, New Mexico, in 1928. Brown had come to this region to probe for the remains of a brand new—or rather very old—type of extinct bison which the Denver Museum had discovered. A vast clutter of bones was found after 20 feet of excavation. Then close study brought something else to light—several leaf-shaped stone arrowheads of a very high order of workmanship, which were mingled with the bones. Brown saw at once that his best course of action was to run, not walk, to the nearest telegraph station and summon an archaeologist. In fact, he sent a score of messages and within the week had about a dozen of the country's top-flight authorities on ancient man buzzing about the digging grounds. An excited conference resulted in a unanimous vote radically to revise the orthodox estimate of Man's first appearance on this continent. Whereas formerly archaeologists were loath to give him more than 2000 years of existence in these parts, the more sanguine authorities now granted him as much as 20,000. Thus did Barnum Brown figure prominently in America's most dramatic archaeological discovery of the century.

Thirty years earlier, he had extracted the first dinosaur skeleton collected by the Museum from a hillside at Como Bluff, Wyoming. In 1937, he returned there on another expedition to find the hole just as he had left it. During the 40 years between, Doctor Brown has led or served on more than a dozen major expeditions to the western badlands of the United States and Canada, returning several times to favored spots in the Rocky Mountain states and in Alberta, which he has found to contain the richest dinosaur beds in the world.

His discovery of the rich Alberta field was a lucky strike, occasioned by the chance remarks of a Canadian rancher who visited Brown's dinosaur laboratory[*] in the American Museum, in 1909. It seemed bones like that were six for a nickel "out my way."

The Museum's Paleontology Department always lends an eager ear to "tips," although seldom does it find them living up to their advance publicity.

But this one was an exception. Brown has unearthed tons of bones in Alberta's Red Deer River valley and knows exactly where he can pick up as many more. Indeed, wartime confinement to this continent is no hardship. In 1938 he made a 45,000 square mile airplane survey of southern Alberta and northern Minnesota, in the course of which he spotted enough promising dinosaur burial grounds to last a lifetime of expeditions. And the year before, he took a whole carload of specimens out of the Cretaceous formation in southern Wyoming.

Despite the magnitude of his own results in sheer tonnage alone, and the tremendous progress of paleontology in the last half century, Doctor Brown feels that neither he nor his colleagues have done more than scratch the surface and that their material is "all too inadequate." But this is an insider's view. To the public, their reconstruction of this planet's early life is a work to wonder at, and though some dinosaurs were as small as a barnyard hen, the layman doubtless continues to think of them all as giants like the record-breaking 67-foot long Brontosaurus in the Museum's Jurassic Hall. The acquisition of this "champion," by the way, reveals a side of zoological collecting which smacks of operations in big-league baseball rather than in a Museum. Three expeditions had worked on this specimen with the result that the University of Utah, the National, and the Carnegie Museums

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[*] See also D. R. Barton, "The Indoor Explorer," NATURAL HISTORY, May, 1938, p. 385.

Natural History

ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration painted by F. L. Jaques, from Bird Group of Hudson Bay Region in the American Museum of Natural History

[illegible] tion until Barnum Brown turned [illegible] tail, thus gathering the fruits of all the expeditions in one big "four club deal."

[illegible] spectacular members of the dinosaur [illegible] fundamentally, it is popular enthusiasm that has made possible much of the scientific work of reconstruction accomplished by men like Barnum Brown. [illegible] kind of support is heartily welcome, [illegible] lars to excavate and ship such skeletons [illegible]

Professionally speaking, Brown lives much of the time in a world [illegible] seems to have been built to scale in [illegible] the still earlier reptilian vintage might [illegible] Brown once had to build sixteen miles [illegible] nosaurus rex out of the badlands, and then transport it 125 miles to the railroad. [illegible] to life today, they could peer into fourth story windows without any danger of coming down with a stiff [illegible] tiles who ruled the earth for millions of years.

Yet when all is said and done, the sauropods were not, with one or two exceptions, nearly so romantic as they now seem at a distance of 140 million years. For one thing, they were very [illegible] were the dumbest. One kind, 50 feet long, had a brain that weighed an [illegible] them had an extra "brain" (or muscle-controlling nerve center) located in the hips. However, the rhymster's pun to the effect that this attribute enabled [illegible] "They had low metabolism and ate comparatively little in spite of the plentiful vegetation on all sides, their behavior being comparable to that of [illegible] our own day."

Barnum Brown's mind is a teeming storehouse of data on the habits and [illegible] the [illegible] of their organs. His colleagues are, in fact, forever plaguing him to knock off exploring long enough to get it all down on paper. For instance, Brown's discovery that one species could actually regenerate the vertebrae in its tail—a feat which, roughly speaking, would correspond to [illegible] a new leg—is as yet unpublished in spite of its being a unique phenomenon in prehistoric vertebrate biology. But as the years advance [illegible] to commend this and similar nuggets to the permanent archives of both scientific and popular literature.

With so much left to be done, Barnum Brown would [illegible] any suggestion that his brilliant career of expedition was something to look back upon. Yet by virtue of fellowships, councillorships, and other ceremonial tokens of honor which have been bestowed to signalize his outstanding position in paleontology, he is already something of an immortal. And under his guidance the American Museum's dinosaur treasures have waxed so great that if the two or three collections which rank next to his were to be lumped together, they would still come off a poor second.

LETTERS

[illegible]

Probably the majority of plethodons do lay their eggs on land, and so do certain individuals of other amphi- [illegible] Exceptions complicate the simplification of almost every biological question. "Dependence on moisture" would be a better distinction for the amphibians than "dependence on water." Even the land-laying amphibians generally lay their eggs in moist locations, such as are afforded by caves or damp sections of a forest floor. These exceptions to the rule of amphibian dependence on water represent animals that have adapted themselves toward drier environments. But none of them has a protective amnion in the egg as all reptiles do, nor an allantois, which facilitates absorption of oxygen when the egg is dry.—ED.

Sirs:

We had not seen this wonderful publication until it was sent us as a Christmas gift last Christmas. It is a joy to us all and we take great pleasure in passing it on to friends.

Mrs. J. W. McMannis

Kansas City, Kan.

• • •

Sirs:

Enclosed is my remittance for renewal to the best magazine in the field of natural science, Natural History, a magazine that [illegible] for each number which is sufficient indication of its worth and popularity.

More power, prestige, and publicity to it.

[illegible]

[illegible]

NOTICE Readers are encouraged to submit their own photographs of natural history subjects. Those published in the Letters Department will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

YOUR NEW BOOKS

AUDUBONIANA ● PLANETS ● VAILLANT'S AZTECS OF MEXICO
A LOT OF INSECTS ● CRATER LAKE ● AMERICAN WATER BIRDS
THE BIG ZOO ● LANDS OF NEW WORLD NEIGHBORS

THE BIRDS OF AMERICA

- - - by J. J. Audubon, Introduction and Text by William Vogt

Macmillan, $4.95

IN 1937 there appeared a one-fourth size edition of the plates of Audubon's elephant folios of North American birds, priced at $12.50. Bird lovers who marveled at this seemingly moderate price now have further cause for wonder in the publication of a later reprint of the same book for less than $5.00. Thanks to the enterprise of the Macmillan Company, a reprint of Audubon's great work, originally published in an edition of about 200 copies, at a cost to the individual subscriber of one thousand dollars, will doubtless become among the best sellers of American bird books. When we consider other forms of Audubonia which continue to command a public, it is clear that Audubon's fame grows with the years.

The first edition of this reprint was reviewed in NATURAL HISTORY Magazine for January, 1938. It is therefore only necessary to add here that in the present printing there is still further departure from the colors of the original. This is shown particularly in the increased intensity of reds and yellow which in a regrettable number of cases produces birds unknown to science. As one examines these illustrations, he realizes how much more fortunate is the quoted author than the quoted artist. The reprinted word is set anew and the integrity of black ink is uncompromising. But the color reproduction, none too good at the beginning, shows with each successive generation the inherited results of increased wear and decreased care.

F. M. CHAPMAN.

AZTECS OF MEXICO

- - - - - by George C. Vaillant

Doubleday, Doran, $4.00

AS the subtitle, "Origin, Rise and Fall of the Aztec Nation," indicates, the present book covers the entire life cycle of one of the most colorful and important peoples in the New World. Set in a broad frame of reference outlining the unique origins of native American civilization, one here reviews, as in a living pageant, the succession of peoples who contributed to the dynamic Mexico of today. From the first agricultural and religious strivings of the Middle Cultures, through the glory of the Toltec Civilization, the decline of Mazapan, and the modest beginnings and penultimate triumphs of the Aztecs, the reader participates in a new and vivid life. Through all runs the "sensation of omen" so dominant among the Aztecs. The grim closing chapter of the old life, the Spanish conquest, is depicted from the Indian sources and this throws much new light upon the causes underlying the sudden collapse of Aztec civilization before the strange war policies and weapons of a handful of daring European adventurers. Unlike his great predecessor, Prescott, Vaillant does not believe that the conquest extinguished the fire and genius of the native population, and the great renaissance of folk culture and art in Mexico today strongly supports his opinion.

Aztecs of Mexico is that *rara avis*, a book planned for the general reader which is, at the same time, a genuine scientific contribution. No one who has tried to unite the mighty but often dry bones of archeology with the living but complex data of ethnology will doubt the author when he says it was a hard book to write. It is not, however, a hard book to read. For the layman, the unusually piquant text and vivid illustrations should open a new world—while for the serious student the skillfully ambushed notes, charts, and bibliography blaze a trail into the very heart of New World anthropology. Such books are rare.

DUNCAN STRONG.

FISHING IN THE CAROLINAS

- - - - - - by Philip A. Murray, Jr.

University of North Carolina Press, $2.00

MR. MURRAY wrote me some years ago that he had in mind a handbook of fresh-water fishing in the Carolinas, hoping it would prove a real contribution to his State. This book, published since his sudden death in July, amply fulfills his hopes and in an admirably condensed form.

Clearing the land in the Piedmont region started erosion, and began the depletion of fish. This was further advanced by lumbering operations, pollution, power dams, and illegal and overfishing. Mr. Murray discusses means of restocking and conservation. He includes brief technical descriptions sufficient for identification of the more important fish both for commerce and angling, and describes methods of angling, giving a short account of the history of the sport. The book is intended for the average reader, not for scientists, and is written in accordance with the author's belief that a fundamental knowledge of the anatomy and habits of fish enables the angler to get a larger amount of satisfaction from his art.

F. LAMONTE.

EARTH, MOON AND PLANETS

- - - - - - by Fred L. Whipple

Blakiston, $2.50

BETWEEN THE PLANETS

- - - - - - by Fletcher G. Watson

Blakiston, $2.50

THESE are the first two of the nine projected "Harvard Books on Astronomy" to reach my desk. It is a pleasure to predict that their excellence will assure a warm welcome by amateur astronomers and teachers of astronomy everywhere. Although written for the nonprofessional, they are, as they should be, scientifically accurate, up-to-date, and surprisingly complete. There is much fascinating astronomy here that this reviewer has not seen in popular books, or in any books for that matter.

Doctor Whipple tells the story of the planets, their atmospheres and physical conditions. He discusses the possibility of life outside the earth, and the theories of origin and development of the solar system. In the light of the latest research, the moon is considered with regard to the probable story of its craters, mountains, and other features, as well as to its origin.

All astronomers will be grateful for the superb photographs of the planets made by E. C. Slipher of Lowell Observatory, including those of Mars made in South Africa in 1939. Another unique feature of the book is The Planet Finder, which enables one to locate the naked-eye planets in the sky from 1940 to 1970.

Doctor Watson, in his book *Between the Planets*, discusses the asteroids, comets, and meteors. He tells the story of the asteroids, or little planets, from the discovery of Ceres in 1801 down to the present time when some 1500 are known. He treats the history, anatomy, and motion of comets; how Jupiter captured his family of comets; and how comets disintegrate or waste away.

Without much doubt the author's favorite topic in the book is meteors and meteor craters, and here we have the latest information regarding meteor showers and disintegrated comets; velocities, and what these indicate in regard to the origin of meteors and their relation to the solar system; the principal meteor craters, and the largest and most striking meteorites in the world; and how to identify meteorites, either stone or iron.

Here are two new books on astronomy that can be recommended without reserve.

CLYDE FISHER.

PAGEANT IN THE SKY

by Raymond S. Deck

[illegible]

M[illegible]

[illegible] ter, and the woodcock is treated with sim[illegible] to the story.

All this is written in a pleasing, conversational style that is easy to read and [illegible] chief interest is not in the study of birds.

Most of the text is accurate although there are a few statements that occupy debatable ground or need clarification. The supposed alternate wing beat of the chimney swift is an optical delusion, as the [illegible] doubtful whether any land bridge existed between South America and Africa recently enough to have permitted an interchange of bird life. The molt of birds' wing quills commonly begins near the middle of the row, not at the innermost end. In some species of hornbill, it is the female, not the male, that does the work [illegible] (with herself inside), although the males of certain species may bring the materials. And again, some young birds are known to reveal the entrance after the mother bird has left the nest.

Contrary ideas on some of these and other points were long of current belief, and it is not surprising that Mr. Deck has overlooked the more recent corrections. The faults would be more serious if this were a textbook of ornithology instead of a work designed for popular consumption. Perhaps only a carping critic would discover them in the assemblage of information here pleasantly presented.

[illegible]

ART IN ANCIENT MEXICO

- - - - - - - by Gilbert Médioni
and Marie-Thérèse Pinto

Oxford, $10

ART IN ANCIENT MEXICO is a significant contribution to the corpus of carefully photographed examples of pre-conquest Mexican art. It includes the best of the sculptures assembled by the great Mexican painter, Diego Rivera. His point of view in assembling this collection was not that of an academician or a scientist. It was that of a keenly modern artist seeking discriminatingly those elements of the past which are of most interest to the aesthetics of the present day. Therefore there is little emphasis on the somewhat turgid ceremonialism of the [illegible]

In their subtle and [illegible] Mexican sculpture depends on tactile values that two-dimensional reproduction often thwarts appreciation. This difficulty the authors have overcome by their recognition of the sense of touch and their ar[illegible] this aspect.

We have given credit to Mr. Rivera for assembling his collection, to the authors for recapturing in this book the spirit of the ancient art and the aesthetics of a modern artist. We should not neglect to compliment, likewise, the Oxford University Press for their foresight in bringing out this book and on their care in providing the beautifully printed text and excellently reproduced illustrations.

There are a number of books on Mexico which are gauged to reproduce our knowledge of the ancient arts. This book, so far as I know, is the first to tie together the interests of modern artists with the product of their Indian predecessors several centuries ago. It will give the peruser a real aesthetic experience in bringing the interest of the ancient artist vividly to the fore.

George C. Vaillant

LIVES AND DOLLARS

by J. D. Ratcliff

Dodd, Mead, $3.00

THIS current volume by Mr. Ratcliff, author of *Modern Miracle Men*, is of interest principally because in some of the chapters the reader is brought right up to date on certain contemporary contributions in the field of medicine and public health, which show promise or are of distinct proven value. Mr. Ratcliff also mentions the names of the various investigators under consideration, in a manner that leads us to believe that he must have visited a number of laboratories and institutions where important work is in progress, in order actually to interview the investigators and to witness their work.

Mr. Ratcliff also writes about the nonmedical phases of scientific advances. His chapters on the atom age, and agricultural research, including the many enemies which attack our crops, make very interesting reading. So, also, does the one about glassware, upon which the scientist is so dependent for his work. Other chapters retell stories which are already familiar to those interested in the field of medical science.

Mr. Ratcliff's *Modern Miracle Men* is a thoroughly enjoyable book and well-written too, but the volume under consideration seems to have been much more hurriedly put together. Also the super-journalistic and sensational style, absent to a large extent in his other volume, does not add to the attractiveness of *Lives and Dollars*.

[illegible]

A LOT OF INSECTS

by Frank E. Lutz

[illegible]

M[illegible] often. In other words we are orthodox in our ideas, scientific as well as [illegible] mainly traditional, psychological, and eco[illegible] noxious creatures. Orthodoxy sometimes goes further and penetrates and enmeshes [illegible] questioning acceptance of traditional theories of insect biology. Doctor Lutz prides himself in being heterodox in these vari[illegible] testation against conventional views as such, but rather a scepticism about accepting any theory or belief without himself carefully evaluating and analyzing the underlying facts.

A Lot of Insects is based on the [illegible] species of insects, representing eleven major orders, that the author observed and collected in his suburban yard (75 feet by 100 feet). Although these represent a tiny portion of the great, complex Class Insecta, nonetheless they are sufficiently representative to provide a host of biological and ecological issues for consideration, especially of the type where man and insect are vis-a-vis. These problems are handled carefully and with scrupulous fairness to all concerned. The sum total [illegible] in the web of life. Brief and illuminating views of some of the craftsmen of entomology are incidentally woven into this picture.

Any layman, particularly one who breeds things, who occasionally exterminates insects, or whose taxes are partially used for insect control, will find the book thoroughly readable and valuable. The style is clear, succinct, and puckish. The language is surprisingly nontechnical yet quite adequate. One may occasionally disagree with some of the conclusions reached or the ideas advanced, but, as another entomologist once remarked, "Lutz's views are always stimulating; never dismiss them lightly."

HERMAN T. SPIETH

CINE-BIOLOGY

J. V. Durden, Mary Field,
and F. Percy Smith

Pelican Books 25c

CINE BIOLOGY is another contestant in the field of popular biology which hopes, through the collaboration of a biologist, an author, and a photographer, to succeed where others have failed. Though in a pocket form and necessarily limited to some of our most familiar invertebrates, it deals adequately with the most important biological problems, in a manner well calculated to stimulate lay interest through abundant use of analogy. For this reason it is all the more unfortunate that its real merits should be belied by a cheap and inartistic appearance and an arrangement of photographs which, though individually good, are confusingly overcrowded.

C. H. C.

LANDS OF NEW WORLD NEIGHBORS

- - - - by Hans Christian Adamson

Whittlesey House, $3.50

LANDS OF NEW WORLD NEIGHBORS is a timely and useful book. It is organized and arranged to combine the drama and excitement of the pageant of New World history with a body of solid, factual information. The arrangement which Mr. Adamson adopts is very useful and original. In appropriate sections he puts down in tabular form the basic information of an encyclopedic character. From this point he is ready to throw his spotlight on each section, to bring out its dramatic qualities. The amount of information which Mr. Adamson has compressed into his pages is formidable. The conclusion which one draws from a brisk perusal is that it is the fault of our educational system that we know so little of our continent.

This book provides a background against which one may read, and to some extent evaluate, the trend of books on continental American themes which have poured from the presses in the last three years. A carefully selected list of popular books enables the interested reader to pursue further any specific interest whetted by Mr. Adamson's text. This Bibliography is largely nontechnical, but it is chosen to bring life and drama to the sometimes stale accumulations of fact.

For a general reader, a reading group, or a library, *Lands of New World Neighbors,* through its text, its Reading List and its Index should be most useful. It is a monument to Mr. Adamson's versatility that he can produce a book that combines all the usefulness of a manual with the dramatic selection of an adventure story.

GEORGE C. VAILLANT.

THE BIG ZOO

- - - - - - by William Bridges, Photographs by Desider Holisher

Viking, $2.00

ONE'S first impression on scanning this book is of an ultra-comprehensive zoological picture gallery embracing all the nooks and corners, the larger enclosures, and the panoramic arenas of the Bronx Zoo. Yet the parade of animal subjects is not merely in the form of portraits. Most of the subjects are active, and a large part of the pictorial story relates to their characteristic antics and their care. By virtue of its detailed captions, its links of continuity, the book seems complete enough as a lively story of camera-recorded human observations among varied animal life, large and small. But after more careful reading, one finds that it also contains a printed story told in the conversational terms that have made Bridges' chats so popular over the radio. Moreover, the thoughtful person who studies this book will be strongly impressed, both from its text and pictures, with the evolution that is taking place in methods of exhibiting animals.

There is little in the possible pictorial history of a big zoo, behind the scenes and outside, that artist Holisher has missed. I say "artist" for he has patiently awaited opportunities, precise moments of action; and to gather such a collection of photographs is a great task. The pictures will be of keen interest to youth and adults, as well as an incentive to amateur photographers interested in animals,—a contingent that is steadily growing in numbers and enthusiasm. As to author Bridges, he has steadily hit upon the high spots and human interest points.

The captions run from 50 to 75 words per illustration, while a few, beneath full-page pictures, are longer. The text consists of an Introduction and four chapters.

RAYMOND L. DITMARS.

AMERICAN WATER BIRDS

- - - - - - by Maitland A. Edey

Random House, $1.00

THE water bird plates by Louis Agassiz Fuertes, made originally for Elon Howard Eaton's *Birds of New York* and subsequently reprinted by the University Society in 1917 and by Doubleday, Doran in 1936, are used to illustrate this volume. It thus supplements the author's *American Songbirds,* which was briefly reviewed in NATURAL HISTORY Magazine for February, 1941, and, like it, is sold for the low price of one dollar. As was said of the earlier volume, the illustrations are acceptable and the text accompanying them "gives a brief description of the markings, manner of occurrence and habits of each species."

The statement on the title page would lead one to believe that the illustrations used in this volume were made from Fuertes' original paintings, now in the possession of the State Museum at Albany, whereas, if we are not mistaken, they were made from electros of the original engravings.

F. M. CHAPMAN.

ARCHAEOLOGY OF NEW JERSEY, Volume I

- - - - - - - - by Dorothy Cross

Archaeological Society of New Jersey,
Trenton, $3.00 (Paper-bound $2.50)

THIS work is a boon to archaeologists in New Jersey, to students of the American Indian, and to amateur collectors. Numerous maps, two large charts, and 73 excellent plates make up an impressive (and cheap) volume.

Of numerous collaborators the most important are H. B. Kümmel, with a brief geographical sketch; H. G. Richards, with an excellent chapter on the relationship of geology and archaeology (in which he proves, incidentally, that the puzzling "red veins" are no indication of great age); and Nathaniel Knowles, with statistical studies of the stone artifacts and of the depth at which these were found. While these elaborate analyses do not result in startling conclusions, they give evidence of the immense care with which the excavations in New Jersey were conducted. The book is chiefly the work of Dr. Dorothy Cross, Archaeological Adviser of the New Jersey State Museum, organizer and director of the Indian Site Survey and its supervisor from 1936 to 1938. Doctor Cross has a sound knowledge of archaeological technique, and her hand is everywhere apparent.

The book describes in detail 39 sites excavated by the Survey and, very briefly, over 600 sites where artifacts have been discovered. But there is more here than mere description. Interpretation of the finds is sane, and discussion of archaeological technique illuminating. There is an excellent treatment of pottery manufacture, together with other discussions of great interest such as artificial concentration of objects, resulting from erosion of surface sand; the disappointment of excavations where objects lay in such shallow soil that most were brought to the surface by plowing; the inferences, derived from pits of fire-cracked stones not mixed with ash, of the practice of sweat-bathing.

The authors conclude that the aboriginal culture in New Jersey was homogeneous, presenting no evidence either from stratification or distribution to indicate cultural breaks; that the earliest inhabitants either brought pottery with them or learned the art shortly after their arrival; and that the New Jersey culture is closely akin to "Coastal Algonkin" or to what Ritchie has recently called "the coastal aspect of the north-eastern phase of the woodland pattern."

CASPER J. KRAEMER, JR.

CRATER LAKE: The Story of Its Origin

- - - - - - - - by Howel Williams

University of California Press, $1.75

A FEW months ago this reviewer was privileged to appraise a small volume, entitled *The Tetons: Interpretations of a Mountain Landscape,* by Fritiof Fryxell, which had been published by the University of California Press. Now they have issued a similar small volume (97 pages), concerned with Crater Lake, another of our National Parks. While Professor Williams may not produce the superb descriptions which earn for *The Tetons* a place in the field of pure literature, as well as in that of science, he displays more than average ability to tell the dramatic story that is exposed to the scientifically trained observer by the record in the rocks of Crater Lake. And in Professor Williams, who has spent several years studying volcanic phenomena and the history of this region, we have the best observer available to interpret that story and to tell it in dramatic and convincing, but nonscientific, language.

The work is divided into two parts. The first, entitled "The Story," describes the development of Mount Mazama, the great volcano which reared its crater far above the present Crater Lake; its violent eruptions and subsequent collapse; and the formation of Wizard Island and Crater Lake. The second part, as its title, "The Evidence," indicates, is concerned with the geological evidence upon which "The

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H. E. Vokes

[illegible]

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77th STREET AND CENTRAL PARK WEST, NEW YORK CITY

NATURAL HISTORY

THE MAGAZINE OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

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The Taming of a [illegible]
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January **NATURAL HISTORY** 1942

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THE MUSEUM AND HUMAN BETTERMENT

WE OF the Museum believe that Man's ignorance, selfishness, and brutality must be combatted by teaching old and new truths of Nature and that Nature will provide both the knowledge and faith upon which Man can build for the future. These truths are revealed in the halls, laboratories and teachings of our Museum.

We proclaim a world where people live in harmony with Nature, and this presupposes Man's greater knowledge of Nature and his relationship to the world and his fellow man. Appreciating Nature, Man will conserve and utilize—not waste and destroy its resources—, so that these resources will be available for human betterment.

It is also essential for Man to control forces within himself. This requires more fundamental knowledge of Man's origins, physical make-up, and above all, his instincts and emotions. Man is said to be the slave of his emotions. But the pages of history show that selfish leaders use their knowledge of human psychology to enslave Man. The Museum proclaims that Man, through greater enlightenment and better understanding, will free himself from such slavery and build a social framework strong enough to bear the weight of the future.

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A Perry Osborn

First Vice-President of the Board of Trustees,
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The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Wayne Moody Faunce, Acting Director

VOLUME XLIX—No. 1 ★ ★ ★ ★ ★ ★ **JANUARY, 1942**

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From a Kodachrome by Thane Bierwert and Robert E. Logan

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The Devil's

One of the most dramatic chapters in our frontier history is the epic story of a road on which more than 100 persons have perished from heat and thirst, the last of them within the past few months

TULE WELL
TULE TANK 1600 FE

Y[illegible] the United States on which [illegible] [illegible]

At Wellton, Arizona, our starting point, they told us of another desert death. "We found his body three miles from his car," they said. "He'd taken the last of his radiator water at a [illegible] and wandered north. He was under an elephant tree—dead for about a month." This was a prospector looking for the legendary riches of El Camino del Diablo—the Devil's Highway, whose record is unparalleled in the whole of North America.

From the Gila River, in Arizona, to the little Mexican hamlet of Sonoyta, sleeping fitfully in the desert silence just below the border, there are still visible to the rare traveler the tracks of wagons along this old trail. From time to time a little pile of rocks, sometimes surmounted by a rude cross, sometimes by a broken wagon wheel, marks the final resting place of some thirst-crazed passer-by. Sometimes one comes across the skeletons of horses, burros, or cattle, and sometimes there is a glimpse of a bleached human skull beneath the twisted cactus.

The Devil's Highway is a short cut, a chord to the vast arc of the Santa Cruz and Gila Rivers, permitting a saving of 200 miles from the old Spanish settlements in Sonora to the Colorado River. Long before the coming of the white man, primitive Indians shuffled along the trail, using it as a trade route between the Papago country and the Gulf of Baja California.

The first white man known to have traveled this Devil's Trail was Padre Eusebio Francisco Kino, Great Apostle to the Pima Indians, famous pioneer missionary in northern Mexico and southern Arizona. Father Kino, accompanied by Captain Juan Mateo Mange, made the journey in February, 1699. Leaving Sonoyta, the little party of Spaniards and Indian guides pushed on to some *tinajas*, rock pools or "tanks," which he called Agua Escondida, "hidden waters." These are the famous Tinajas Altas of later travelers. Here the Spaniards counted "30 naked and poverty-stricken Indians who lived solely on roots and [illegible]

They said that if we were not back "out" in seven days, they would start "in" for us. Heading the trusty convertible south over a faint trail, Randy Gunter and I bounced and bumped along at four miles an hour in a car whose usual cruising speed was sixty. The car was equipped with oversize tires—for the sand we had been warned about. In a few hours we reached the northwestern portion of the old trail—the Devil's Highroad.

It took us the whole of the first day to reach Tinajas Altas from Wellton, a distance of only 27 miles. Some of this time, of course, was spent in cutting brush and putting it under the tires, deflating and reinflating the tires, shoveling, pushing and fighting in the hot sun to get the car through the treacherous sand washes that abound in this lonely and untraveled country. (And also we did spend some of this time just cussing.)

Late that afternoon my companion shouted, "There it is!"

The faint tracks we were following turned in toward the mountains. At the foot of a steep granite cliff there was an old, bullet-riddled sign.

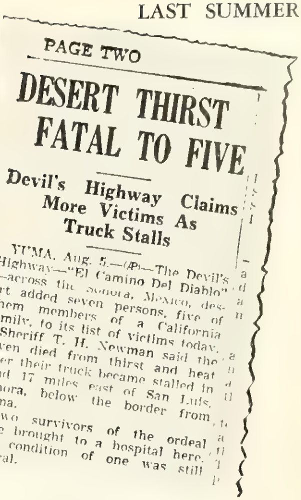
We had reached Tinajas Altas.

Tinajas Altas is a little cove in the great granite mountains. It is a small canyon leading up to a steep, smooth watercourse where there are "usually" water holes in the rocks. Up higher, above the water holes, is a "hanging valley," typical of this particular mountain range. This hanging valley is a geological indi-

Highroad

By
SHERMAN BAKER

LAST SUMMER



PAGE TWO

DESERT THIRST FATAL TO FIVE

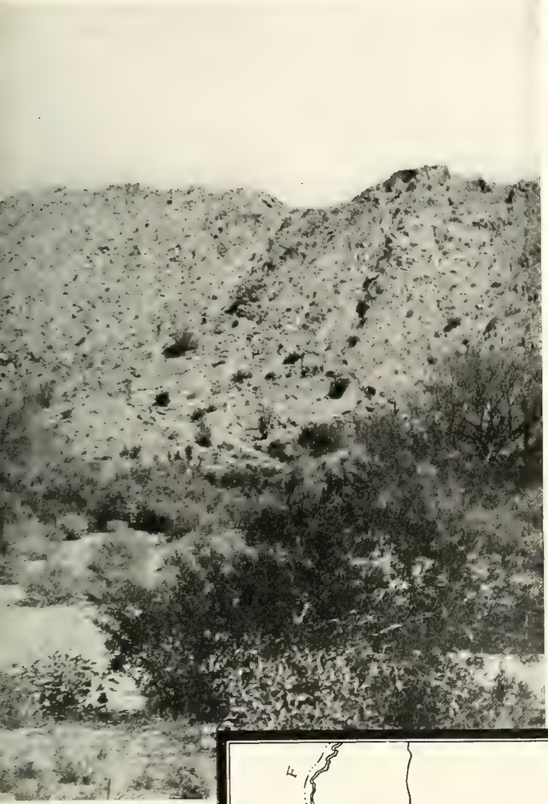
Devil's Highway Claims More Victims As Truck Stalls

YUMA, Aug. 5.—(AP)—The Devil's Highway—"El Camino Del Diablo"—across the Sonora, Mexico, desert added seven persons, five of them members of a California family, to its list of victims today.

Sheriff T. H. Newman said the seven died from thirst and heat after their truck became stalled in sand 17 miles east of San Luis, Sonora, below the border from Yuma.

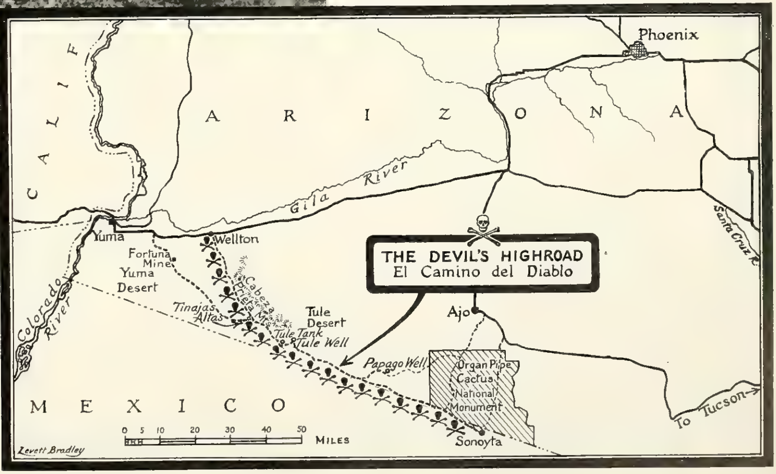
Two survivors of the ordeal were brought to a hospital here. The condition of one was still critical.

Photographs by the author taken specially for
NATURAL HISTORY Magazine



(Left) A SCENE NEAR the center of the merciless desert road in southwestern Arizona, on which Government expeditions have found as many as 65 graves in one day's horseback ride. In one spot an entire family had died of thirst within a few yards of one another. The bullet holes on the signs may well symbolize the feelings of travelers for the miles ahead they dread

FIRST TRAVELED in 1699 by Spanish priests, the Devil's Highroad lured later travelers as a short cut to the gold of California. Near it too was found a nugget of pure silver, weighing over one ton


Phoenix
CALIF
A R I Z O N A
Gila River
Santa Cruz R.
Yuma
Wellton
Fortuna Mine
Yuma Desert
Colorado River
Tinajas Altas
Cabeza Prieta Mts.
Tule Desert
Tule Tank
Tule Well
THE DEVIL'S HIGHROAD
El Camino del Diablo
Ajo
Papago Well
Organ Pipe Cactus National Monument
To Tucson
Sonoyta
M E X I C O
0 5 10 20 30 40 50 MILES
Levett Bradley

[illegible] the mountains were [illegible] the plain, probably in Quaternary time.

With a [illegible] the [illegible] to the water [illegible] every drop we had [illegible] from our canteens, we prowled around to explore.

"Mortar holes!" my companion called, pointing toward a low rock in the watercourse. I ran over to [illegible].

"Yes, and sherds, too." We stooped and examined the abundant fragments of pottery and the deep circular holes ground by forgotten Indians in long years of [illegible]. We found some [illegible] an arrowhead, and then a sea shell, brought by some ornament-loving Indian woman from the Gulf of Baja California.

Here we saw the strange elephant tree (*Elaphrium microphyllum*)—a primitive-looking growth that seemed like something out of another world, with its squat, cream-colored trunk, and many sharp-pointed clusters of [illegible] lavender [illegible]. The [illegible] leaves resembled mesquite leaves, and were intensely fragrant, like balsam. The whitish roots of this tree twisted and writhed like great snakes among the hot rocks.

Here was another [illegible] from [illegible].

"Look! Here in this cave!"

Near the water holes, in a shallow cave, there were dozens of Indian paintings, red, black and white.

The buzzards that circled overhead gave us an uncanny feeling. Everything was lonely and weird. The silence seemed to rush up and overwhelm us—a silence from the prehistoric, forgotten past. We could think of the many men, Indians, Spaniards, Americans, who died of thirst in this eerie country. And we thought of those who managed to crawl to the life-giving water, just in time—

Who were these men? Historians have but the vaguest idea. Father Kino made several trips along the Camino. First, in 1699, then in 1700, and again in 1702, with Father Salvatierra and Father Gonzales. In 1736, on the eastern edge of the Devil's Road, there was great excitement. An immensely rich, but probably shallow, deposit of pure silver was discovered. The little mining camp that sprang up was known as Arizonac, a name that was most likely the origin of the name of the present state. We have good authority in believing that the world's record silver nugget came from this region. It was a mass of pure silver with the amazing weight of 2700 pounds.

Padre Sedelmair, Padre Garces, and Captain Anza were other Spaniards who trod the treacherous trail. And in 1775 the lonely wastes of the Devil's Highroad echoed with the tread of over 200 white men—soldier-colonists for California.

From the days of the Spaniards to the discovery of gold in California there was a long period of emptiness and loneliness for this desolate road. The faint tracks in the sand were soon blown over and the little campfire sites covered up with drifting, dry dust. Year after year the parching desert wind sobbed its eternal song of desolation and of death. Year after year the bighorn sheep drank from the lonely water holes, and the rattlesnake wound its death-dealing length in the deep shadows of the rocks, unseen by human eyes.

And then came the Gold Rush.

When the lure of gold drew men to far-off California, the barren rocks along the Camino rang with the lustful tread of marching men. It was during this period of the Gold Rush that the dreaded Camino claimed most of its victims.

From 1849 on into the early 'fifties, hurried and inexperienced parties were organized in Texas, and improperly equipped, rushed headlong into the desert wastes along the shimmering, dazzling, Camino del Diablo. Without guides, without sufficient water, the gold seekers plodded along mile after mile, until their horses and cattle died from exhaustion and thirst. Then, stark-naked in their frenzy, with blackened tongues and shriveled lips, the shrunken, scorched travelers stared out of lidless, seared eyeballs at the miles of sun-blasted desert ahead of them. One after another they dropped in their tracks and died.

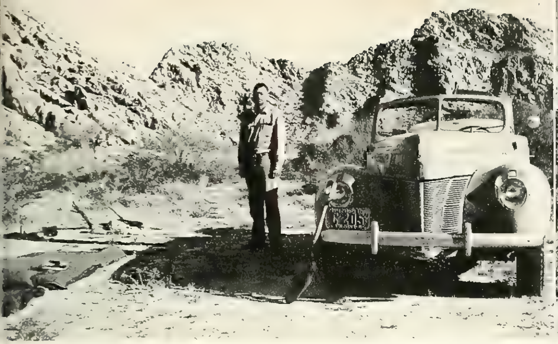
Sometimes other parties of gold seekers hurrying to California would stop and pile rocks over these twisted, mummified bodies. Government expeditions in recent years have found 65 of these graves in one day's horseback ride. One large pile of rocks contained the bones of an entire family whose horses gave out and who died of thirst within a few yards of one another.

Our campfire was dying down. I picked up a chunk of dead ironwood and threw it on the embers.

The wind sighed over the sharp granite crest above us. My friend stirred the fire with a stick. All around us we could feel the presence of these nameless, forgotten gold-crazy people who had died all along the Camino.

Right near us, here at Tinajas Altas, over 50 graves had been counted. Some historians estimate that several thousand deaths occurred along this Devil's Road during the wild years of the Gold Rush. No one can ever know.

The next morning we explored the locality. It was a real oasis in the desert. During the coolness of dawn the song sparrow and the cactus wren made the air beautiful with their liquid songs. While making breakfast I saw a dove near one of the water holes.

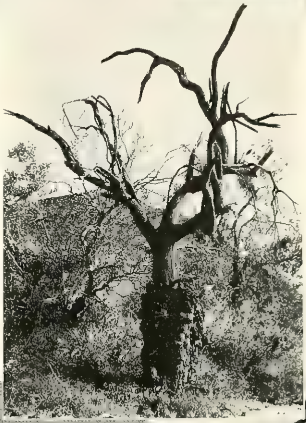


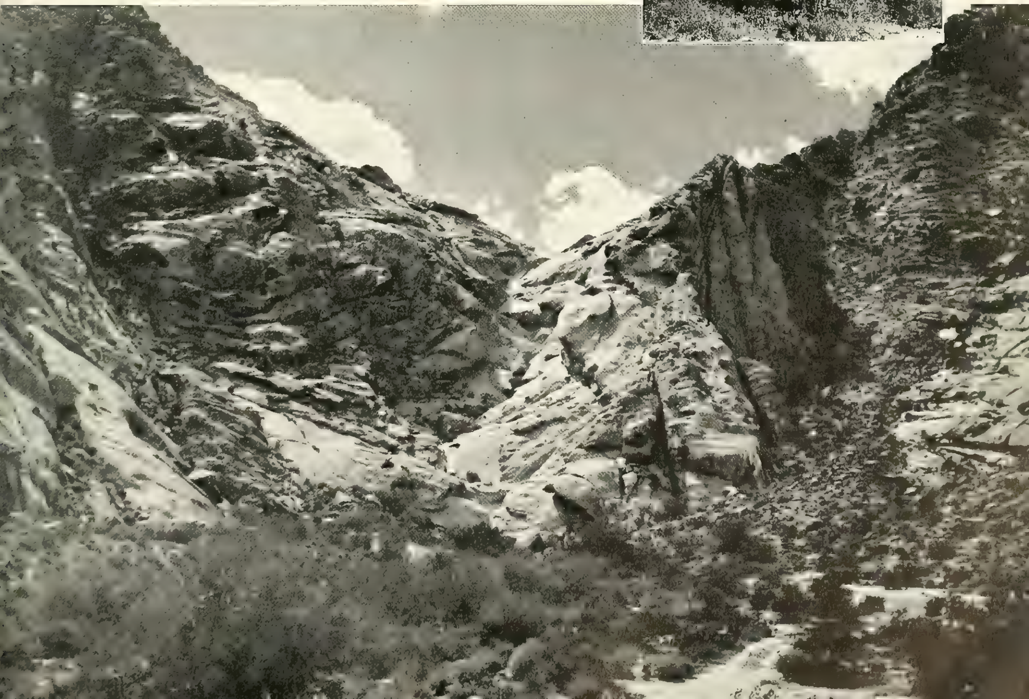
THERE'S NOT MUCH to a camp in Arizona—sleeping bags, food, a campfire, a car, and gasoline,—but one who attempts to travel the notorious Devil's Highroad must take special equipment and use careful foresight

SETTING OUT ACROSS the Lechuguilla Desert, the traveler faces many waterless miles. Loose, deep sand *(above, right)* was the greatest hardship encountered by the author and his companion in traversing the old trail

OUT OF THE PARCHED EARTH a dead ironwood tree *(right)* raises its gnarled branches against the blazing desert sky. Temperatures of 126° in the shade and 160° in the sun have been recorded on the Devil's Highroad

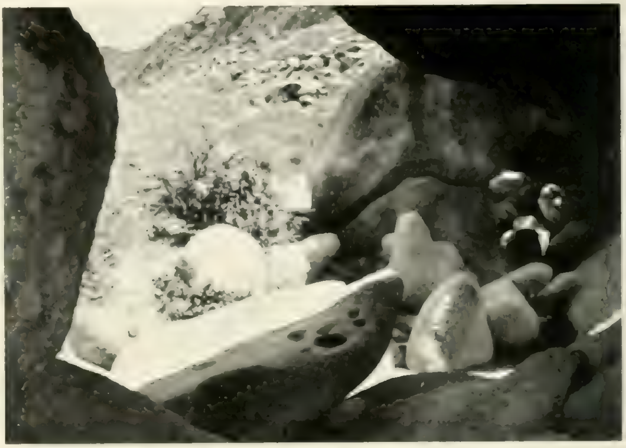
(Below) AN OASIS in the desert: Tinajas Altas, the "hidden waters" referred to by early travelers. One natural "tank" is at the base of this cove in the great granite mountains. A second and third are one-fourth the way up, and six others are at or near the top





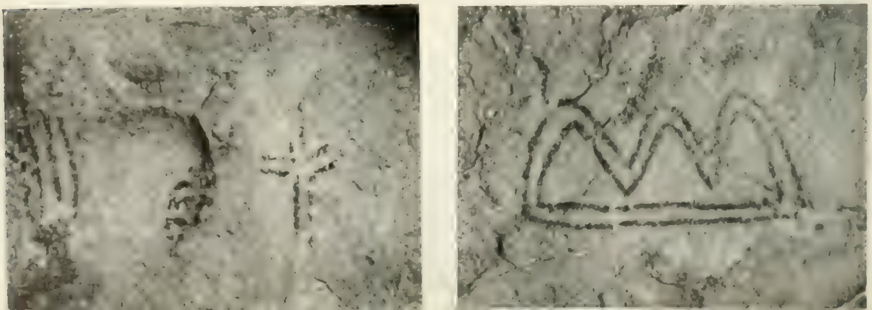
TANK TWO, a welcome basin in the rock to the desert-weary traveler, is visible beside the figure above

LOOKING DOWN from another point at Tank Two, with the camera at a steep angle



(Right) THE FIRST SPANIARDS to travel the Devil's Highroad found "50 naked and poverty-stricken Indians who lived solely on roots and lizards" at Tinajas Altas. Here are some vestiges of their presence: mortar holes in the rock in which they presumably ground corn. The author and his companion counted about 150 of these holes

(Below) DOZENS OF INDIAN PAINTINGS in red, black, and white decorated a shallow cave at Tinajas Altas. The travelers also found abundant pottery fragments, an arrowhead, and a sea shell doubtless brought by some ornament-loving Indian woman from the Gulf of Lower California



Cream-colored trunk, bright lavender branches, and whitish roots twisting snake-like among the hot rocks give this elephant tree a weird, unearthly appearance

(Below) The Cabeza Prieta Mountains gleam brightly across almost 20 miles of desert from Tinajas Altas

Farther to the southeast the old Devil's Highroad winds through an unusual profusion of desert plants — jeweled wild flowers, pungent greasewood, and spiked ocotillo

We [illegible] swallowtail butterflies. I heard the call of the wild Gambel's quail. And during the night a rat had done his best to steal our supper after we had rolled up in our bedrolls. Near the water holes there were many signs of bighorn sheep, and I found a sheep horn and a dried sheep carcass. There were also wild burro tracks and coyote tracks.

Having packed our meager camp outfit in the car and filled our canteens brimming again, we started out once more, traveling east along the Camino toward Tule Tank, the next water hole. Water was also "usually" to be found here, we had been told.

Bouncing along at our four-mile-an-hour pace we came across a curious circle of stones about twelve miles from Tinajas Altas. It was some sort of Indian ceremonial spot, evidently. Inside the circle was an anthropomorphic figure, oriented toward the north.

Then, bumping cautiously along the trail between the Cabeza Prieta Mountains and the Tule Mountains, we came to a sand wash. It was like a hundred sand washes we had easily crossed, and after a moment's reconnaissance, we started to cross it. Halfway across the hind wheels started to sink in. We stalled.

"Blow sand!"

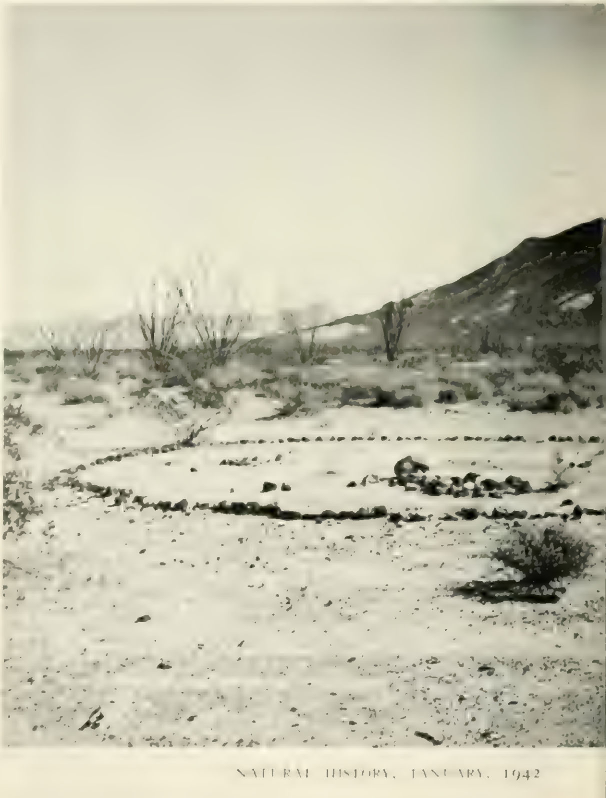
My comrade was right. It was the dry, powdery sand, fine as dust, into which car wheels dig deeply and quickly. It was almost as bad as quicksand.

He chopped brush to put under the wheels, while I [illegible] in front and a [illegible] in the sun. Then we sat in the shade of the tilted, trapped car, and rinsed out our parched mouths with water. I remembered what they told me in Wellton about the last few deaths along this road. "Water," "lack of water," "drank all their water," and so on. It suddenly came to me that the radiator of our car was filled with a bright orange antirust solution. Was it poisonous? It certainly looked it.

They had told us that if we did not come "out" in seven days, they would come after us. With luck we could get along for a week, if we husbanded our water and didn't exercise.

Then we got back to work. We let most of the air out of our rear tires, laid mesquite branches across the wash and under the tires, and cut down the slope of the farther bank. Another swallow of water in my mouth and I got in the driver's seat. I started up the motor, put it in gear, and released the clutch. The car began to creep forward as the brush gave traction

(Right) THE AUTHOR and his companion discovered this curious circle of stones along the old trail near the Mexican border. It is apparently an Indian ceremonial place. The stones in the center form a figure in the likeness of a man



A GRANITE PEAK capped with black lava, Cabeza Prieta is well named "Black Head." Arizona's State Flower is the blossom of the saguaro (sa-gwah'-ro) cactus *(foreground)*

under the tires. The car was out, back on solid earth again!

We had a real drink of water then.

We reached Tule Tank safely and found water there—green-scummed water, but precious to us. We camped beneath a big paloverde in the dry wash. Tule Tank consisted of one large pool of green water in a hot furnace of orange rocks. It reminded me of what I had read about the Danakil country in Abyssinia.

A few miles beyond Tule Tank was Tule Well. This was dug by an enterprising Mexican in the 'sixties. Here he had built a rude house, and sold water and supplies to travelers. But he charged somebody a little too much for a drink once and was shot. The place became deserted and the water foul.

Raphael Pumpelly, the noted mining engineer, went through this "land of silence, solitude and sunshine" in July, 1861, on his way to California. He writes of the "barren and dazzling masses of rock" that assail the tortured eye on all sides. His thermometer ranged from 118° to 126° in the shade, and 160° in the sun. He noted "countless skeletons of cattle, horses and sheep . . . wholly preserved in the intensely dry air." Previous travelers, with a grim sort of humor, had propped many of these sentinels upright on their feet, and to Pumpelly "they seemed sentinels guarding the valley of death."

Having used up much more of our reserve gasoline than we had estimated we would, we decided that discretion was still the better part of valor, and that we had better come "out." So, from a little east of Tule Well we turned the radiator north, back toward the paved road.

On the way "out" there was one thing that haunted me about the Camino del Diablo. It was this: in all its varied history, in all its colorful pageantry of Indians, Spaniards, Mexicans and Americans, there was one especially terrible and cruel thing about this deathly Road of the Devil. In the Gold Rush days the gold seekers who managed to survive the worst part of the trail passed along the base of the Gila Mountains. They struggled westward, their tortured minds filled with the vision of California gold. It is the ghastly irony of the Devil's Highway that these poor gold hunters, lusting for the gold beyond the horizon, stumbled blindly within a few hundred yards of what is now known as La Fortuna Lode. La Fortuna Lode in recent years has been developed as one of the richest gold mines in the West.

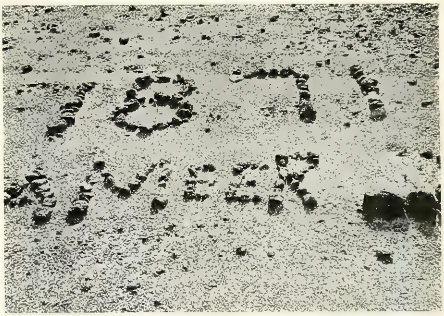


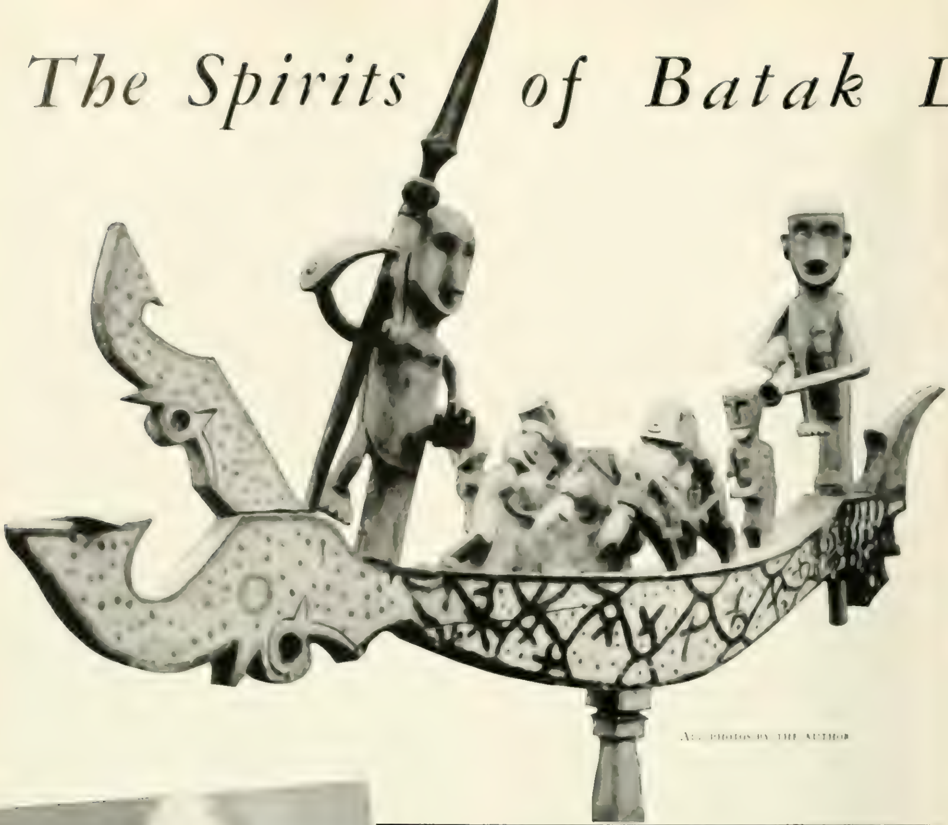
Photo by Tad Nichols

A GRAVE on the Pinacate Lava, east of Tule Well

(Below) IN A NETWORK of slender green lines the sparse vegetation south of Tule Tank shows clearly the watercourses in this arid land

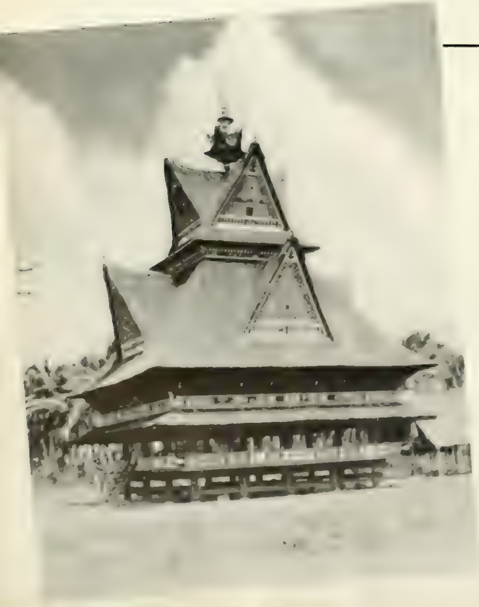
Photo by Tad Nichols

The Spirits of Batak L



ALL PHOTOS BY THE AUTHOR

THE BATAKS OF SUMATRA believe that their early home was in some other land. Therefore when bad times visit them it may be because the dead wish to go to their ancient home. Then their bones are dug up, and a chip from each skull is put in a miniature boat, along with wooden images of the dead, as shown above. All assemble beside the nearest river, and the boat is launched. Voices wail but hearts secretly rejoice as the ship sails away with its ghostly passengers, to carry them to the ancestral land, where they will no longer trouble the living



AGAINST their background of primitive savagery, the Bataks of Sumatra astonish the visitor with flashes of high artistry. The beautifully decorated building at left is a guesthouse in which any wayfarer may sleep. Note the bullock heads on the gables, which indicate the number of animals sacrificed to the spirits when the house was built. Human sacrifices were formerly made

and

By Willard Price*

"Don't look now, but something is following you." In the large island nearest to Singapore, one must invent special languages that the spirits cannot understand and take a multitude of other precautions against the rulers of the unseen world

The tiger's spirit is feared above all others. When a raja killed this marauder, elaborate ceremonies were necessary to avert the wrath of all the tigers, who dwell in a tiger city, in houses thatched with women's hair

We sat on the floor and waited for the tiger. The wavering light of the candle threw great shadows upon the smoke-blackened walls and high roof of the Batak house.

The Dutch schoolmaster, Pieter van Blok, sipped his tea. I toyed with my rice and listened for the step of large padded feet.

But I believe the young king was the most uneasy of the three of us. For he had more than the tiger's jaws and claws to fear. He, being a Batak, stood in dread of the tiger's spirit; for the Bataks believe that of all the evil spirits which inhabit rock and tree and animal, the most terrible live in the tiger.

He was raja (king or chief) of a small Batak village in the island of Sumatra. I was a traveler in search of ethnological facts, and the Dutch schoolmaster, who knew the Bataks well, had volunteered to be my guide through this fascinating country of tigers, orchids, ex-cannibals and—spirits.

When we had asked permission to stay the night in the king's house he had warned us that it might not be a very good night. Recently a tiger had been making frequent visits to the village. It had come under the king's house and stolen some of his chickens. It had come again and devoured a litter of puppies. On its third visit it had leaped up the short ladder into the house itself, seized the king's favorite dog and made off with it. Once more it had come, plucked a child from the street, and carried it screaming, into the jungle.

The village elders met and agreed that the king was justified in killing the tiger. This was a very grave decision. The malevolent spirit of the tiger might stay in the village to sow sickness and death.

(Left) **The first step** in the making of an automobile tire: a native cutting a groove in a rubber tree. In orderly rows the plantation trees here and there displace Sumatra's forest primeval

At right, the cup is placed in position to catch the latex

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*The waters now geysering with bombs and the island peoples who live in the great Pacific area are an old story to Willard Price, author, editor, and traveler. As a student of world affairs and of native peoples he has investigated the natives of Mindanao, Sumatra, and elsewhere, in addition to the Japanese, on whom he is an acknowledged authority. His latest book, *Barbarian,* appeared almost prophetically on the eve of action in the Pacific. It is a historical novel, opening with Commodore Perry's advent and Japan's wholesale adoption of Western ways. It traces the subsequent reaction against foreigners, the return of Japan to a mental feudalism, and the abandonment of democratic methods for totalitarian. The book is called *Barbarian* because that was the epithet applied to foreigners. Mr. Price's vivid and timely article here gives NATURAL HISTORY readers a cross section of the peoples of Sumatra without attempting a detailed analysis of customs by locality.—Ed.

[illegible] of the dead tiger would enter the council chamber of the beasts of the tiger city. It would tell what had been done, and all the beasts would descend upon the village to avenge their dead comrade.

So the village elders made their decision with fear and hesitation. They did not even use the word "tiger," nor did the king when relating these events to us. Roundabout terms are always used in referring to the most dreaded beast in the Sumatran jungle. It is apparently hoped that the tiger spirits, who may be listening, will not understand that the terms refer to the tiger. He is evasively called "the grandfather to whom the wood belongs" or "the old one" or "he with the striped coat."

The young king had gone to a near-by American rubber plantation and borrowed a trap. That trap was now under the house. Beside it was tied one of the village curs. We heard him whining softly. The king listened, his hand on his gun.

"Pardon"

We sat for two hours thus, hardly breathing. Then the dog's laments suddenly rose to a scream. There was the snap of steel, a thunderous roar of pain and a great thrashing about. The king gripped his gun and went down the ladder.

We followed and played a flashlight into the gloom under the house. Two eyes burned like green flames. We waited for the king to fire, but as he took aim he pleaded with the spirit of the beast to pardon him for what he was about to do. Then he fired and the tiger slumped dead. The shot was too much for the already frayed nerves of the dog, who broke his cord and fled, howling.

Villagers swarmed down from the stilted houses and came running. Everyone talked at once. After much palaver, they went gingerly under the king's house and dragged out the carcass.

They put it in the place of honor, the center of the open space before the king's house which stood at the heart of the village. Lanterns were brought to light the scene. The tiger lay with his head between his paws, a picture of great dignity, even in death. Offerings were placed before him, grains and meats and flowers.

Incense was set to burning, and a gnarled old medicine man intoned prayers in a loud voice.

"He is praying that the spirit of the tiger may enter the incense and pass away," the schoolmaster said. "And now he is addressing a prayer to all the spirits of the forest. He is explaining to them why it was necessary to kill the tiger. He is begging them to intercede with the tigers of the tiger city so that they will not come and attack this village."

When the long prayers were done, the people began to dance. They circled round and round the carcass. [illegible] dance to celebrate the killing of the monster that had preyed upon their village. It was a dance in honor of the tiger's spirit. If that spirit were not mollified, there [illegible] dance of dread. It continued until dawn.

Dread of the unseen is the chief force governing the lives of the Bataks. As we went on through the villages, Pieter van Blok lamented the lack of schools and the multiplicity of charms, talismans, shrines, thorns projecting from the corners of houses to catch prowling spirits, knives over doorways to impale them before they could enter the house.

Human sacrifices

Many of the houses are guarded also by the threatening horns of bullocks and buffaloes, whose heads, carved from wood and brilliantly painted, are mounted on gables and cupolas. Their number represents the number of such animals sacrificed when the building was erected. They are a notification to all the spirits that roam the air that the tax of homage to the spirit world has been paid, and immunity purchased. The spirit that would ignore this receipted bill and enter the home to demand a new accounting, would be an evil spirit indeed. Yet this sometimes happens. One of the occupants of a house that fairly bristled with horns said:

"They don't really do much good. It was different in the old days when human sacrifice was made. The spirits were satisfied with that. But the sacrifice of animals is not enough."

Human sacrifice is almost a thing of the past. Human heads are no longer placed under the foundations of Batak houses. This is because the Dutch Government sternly forbids it. Deprived of their custom to practice human sacrifice, the Bataks have created a fantastic folklore about their rulers and believe that the Dutch themselves insure the safety of their buildings in the same way. It is village rumor that the government employs a man who goes about getting heads to place under the foundations of bridges, government buildings, and other public works. He is the bogeyman by which Batak parents terrify their children into obedience. "If you don't do as you are told, he will take your head for the new bridge."

Nor is this belief entertained only by the most ignorant. "The boys in my school have the same notion," said Pieter. His school was not in these wild highlands but down near the ocean's edge in the progressive city of Medan.

Beautiful and productive

Sumatra is in two levels. People of all nationalities live in the steaming coastal towns. The wild tribes have the cool, bracing air of the interior plateau, 4000 feet high, very much to themselves. It is a land of beauty. Active volcanoes toss their white plumes into the sky. A great lake of the sky, Toba, lies cradled in the mountaintops. It is a land of tall timber: oak, camphor, and teak. Here and there the forest primeval has been displaced by orderly rows of rubber trees owned by American or other foreign interests. But they have made little dent upon the jungle. Sumatra is unsurpassed for interesting fauna. Close to the villages hover the tiger, panther, tapir, rhinoceros, elephant, buffalo, deer, and several species of ape.

The Batak village is often surrounded by a high wall made of sun-dried mud. Sometimes the only entrance is by way of a ladder over the wall. If there is an opening in the wall it is apt to be blocked by a stile over which you must climb.

It is impossible to enter unnoticed. Your advent is heralded by dozens of dogs.

The houses stand on stilts and lean forward as if about to walk off. They wear hoods of thatch built high and narrow to shed the frequent rains. The inside is dark except for a beam of light through a hole in the gable and another through the open door.

The ordinary house has a fireplace in each corner, and on each side of the fireplace lives a family. That means eight families in a house. The pigs and chickens live underneath. A Batak residence, when everybody is at home, is not a quiet place.

Some of the houses are beautifully decorated. The Batak, in fact, astonishes the visitor with flashes of culture on a background of primitive savagery. Since before the Christian era, Hindu influence has been felt in Sumatra. Later, some tribes were touched by Islam. But the Batak resists foreign influences. His way of life is essentially his own. His science and philosophy and religion are all compassed in one word —spirits.

Spirits explain everything. "Batak boys and girls are bright, and learn easily," Pieter said. "But the adults are so settled in the theory that crop failures and epidemics and all other ills are due to spirits that it is hard to open their minds to natural causes." Earthquake, eruption, thunder, lightning, wind, rain —all are explained in the same way. In a sudden violent storm which threatened to blow down the houses of a village, we saw the people rush out with swords and spears and slash the air, meanwhile shouting at the tops of their lungs, to frighten away the demons of the tempest.

"Camphor language"

Not only all animals are the homes of spirits, but all trees and plants. The white lumberman who tries to use Bataks as lumberjacks is soon in trouble. For example, there are rigid ceremonies to be observed in the cutting down of camphor trees and extraction of their crystals of camphor. First a flute must be played to calm the spirits of the trees. Then the workmen lie down to dream in which tree the best camphor may be found. The white boss may fume and rage but their sleep must not be disturbed. Finally they rise and, with elaborate delay, select the tree. They generally choose well. During all this time they are using "camphor language." Common terms are replaced with roundabout expressions. The idea is to conceal from the spirit of the tree the fact that he is about to be attacked. If he knew, he might fly while there was yet time, and that would mean that no crystals would be found in the tree.

Now they begin to chant apologies to the camphor spirit, every apology being accompanied by a blow of the ax. When the tree falls the top is instantly wrapped in cloth so that the spirit may not escape. Then the log is split and crystals are picked from the cavities in the wood.

The spirits of all trees receive most special respect from the Batak. Perhaps this is because of the unique beauty and personality of the tree as compared with all other growing things. Not only the sensitive Joyce Kilmer but also these ignorant jungle savages are quick to recognize the living individuality of a beautiful tree. When he must cut one down, he offers the tree spirit a quid of betel and profound apologies. If he later finds sap oozing from the stump he concludes that the spirit is weeping and he propitiates it by the sacrifice of a chicken.

When men are clearing a road through the forest and come upon some magnificent tree which must be annihilated, they spare no effort to make it clear to the spirit that not they themselves but their Dutch overlords are responsible for this dastardly deed.

A young tree is sometimes planted near the stump of a fallen giant to serve as a new home for the evicted spirit. Offerings of betel and money also help to soothe the spirit's lacerated feelings so that it will not be so likely to avenge itself upon its tormentors.

Not only trees but many plants are the abodes of spirits. The ghostly inhabitants of the plants have various powers over human beings. Usually their influence is evil, sometimes good. A branch of the "like iron" plant hung over a sleeper's head will make him

(Left) THE PICTURESQUE BATAK roof in process of construction. The houses stand on stilts and lean forward as if about to walk off. The high-peaked hood of thatch is effective in shedding the frequent rains

(Right) BEAUTIFUL BATAK LAND is a country of sweeping valleys and tall timber. Camphor and teak are found in its forests, and active volcanoes toss their white plumes into the sky

(Left) IN HIS WATCHTOWER overlooking the rice fields, the operator of the scarecrow manipulates his apparatus like a long-range puppeteer. He has cords running to scarecrows in all parts of the field, so that when a bird alights he has only to pull the right string

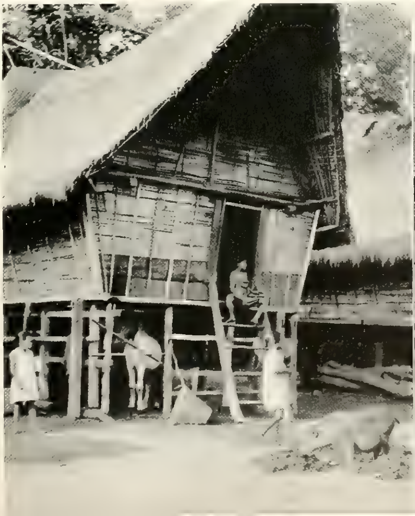
(Below) THIS BATAK VILLAGE in its grove of luxuriant trees is like an island in a sea of rice fields. The spirits of all trees receive most special respect from the Batak

(Left) A VILLAGE OF BATAK LAND overlooking a rice field, from which rises another island of greenery with its sheltered houses

(Above) SOME BATAK HOUSES have elaborate and skillful decorations. Since before the Christian era, Hindu influence has been felt in Sumatra. Later some tribes were touched by Islam

(Below) A HIGHLY ORNAMENTAL rice house. *(Below, center)* A typical dwelling, showing how everything that cannot be gotten into the home is put under it—including cattle

(Below) THE HOUSES of a Batak village thrust their pointed roofs skyward like the bows of ships in drydock. High walls of sun-dried mud often surround the villages



[illegible] complex, and will build up personality and make a man a [illegible] among his fellows [illegible] not yield.

Some of the souls of the dead [illegible] in plants. In the village of Hoeta Gindjang near Lake Toba we asked a [illegible]

He took us through the village. We expected to be led to the finest house. Instead, he presently stopped before a large bush bearing lovely red flowers.

"The rajah died, [illegible] he said. "He now lives here."

In the exquisite and kingly *sepatu* flower the soul of the dead ruler is supposed to live on. Lesser souls transmigrate into lesser plants.

Ancestral spirits

The souls of the dead are man's chief enemies. It is strange that he should fear most the spirits of his own relatives and friends with whom he was on the best of terms while they were alive. Why should a good man in life [illegible] after death? The Batak's explanation is simple. The souls of the dead depend upon the living for everything. If the living do not make offerings of food, recite prayers and go through ceremonies, the dead will starve, be humiliated among their fellow spirits, and perish horribly. The spirits demand so much attention that it is impossible to give them enough. Therefore the spirits are conceived of as being resentful of the lack of honor paid them and resorting to every means to punish the living.

When the ancestors refuse to be satisfied with what is done for them and inflict too many troubles upon the living, the villagers join forces and hold a great feast in honor of the dead.

If adversities continue, an effort is made to ship the ancestors out of the country. The Bataks have a tradition that their early home was in some other land, whence they came to Sumatra. It is assumed that the spirits of their dead relatives may wish to go to the ancient home of the race to join the great company of the spirits of former Batak generations.

The local artisans build a miniature ship. A wooden image of each of the village's most recent and more annoying ancestors is roughly carved and placed upon the ship. Gravediggers exhume the skeletons of the ancestors, take a chip from each skull and put the chips in an earthen jar on the deck of the vessel. Then all assemble on the banks of the nearest river for the ceremony of farewell. Voices wail and hearts secretly rejoice as the ship is launched and sails down the river with its ghostly passengers. The belief is that it carries them to the sea and across it to the ancestral land. There the old ones are expected to be happy and trouble the living no more.

The demons of disease

But the demons inhabiting earth and wood and sky are not so easily banished. When a man becomes ill an effort is made to dispel the demon that is tormenting him. The medicine man fashions a figure of the sick person from a banana stem and dresses it in male or female attire, according to the sex of the patient. Then he conjures the disease demon out of the patient into the image, and destroys the latter.

The medicine man is usually a great character in the village. He exercises a little shrewd common sense and a great deal of hokum. He is usually too intelligent to believe in all of his own remedies. The temptation to trade upon the blank ignorance of his people is too much to resist.

He uses cucumber as a remedy for smallpox, for no better reason than that the native word for cucumber, *gundur*, rhymes with the word for withdraw, *mundur*. If a whole village is overtaken by an epidemic of this disease, the Dutch Government of course becomes active, and more scientific remedies are employed. The people, however, do not take kindly to modern medical practice. They still place more faith in cucumbers. Accordingly these vegetables are in great demand during an epidemic, and pour in from all surrounding villages.

Another remedy, which has now happily passed into disuse, was prepared by the medicine men from the heart and liver of exhumed children too young to have teeth. Parents buried their infants under the steps of the house so that it might be more difficult for the medicine men to steal their remains. Such a medicine was also made from the heart and liver of slaves who were killed for this purpose. The medicine men are still at work in Sumatra, but they have resorted to less gruesome remedies.

For many kinds of sicknesses, including the sickness of love, it is not necessary to take medicines of any kind, but merely to worship a sacred jar, known as a *balanza*. This is most efficacious in bringing a recalcitrant sweetheart to terms. It also has an excellent effect upon the crops.

Another magic device more commonly used by the Menangkabau people of central Sumatra, but occasionally employed by the Batak, is the bull roarer. This may be made of wood, or better, of the frontal bone of an especially courageous ancestor. It is so designed that when whirled round and round it gives out a roaring sound. The demons do not like it.

Disease flies before it. It can be used not only to cure one's own troubles but to make trouble for others.

For the lovelorn

The rejected lover may seek revenge by means of the bull roarer. He must first get some of the offending woman's hair, and attach it to the instrument. Then the roar of the whirling slat, and the swish of the hair, is accepted by the demons as a command to wreak vengeance upon the fair one. They steal her soul, and she goes insane.

Perhaps the most extraordinary source of magic power in Batak Land is the tombstone of two Americans. In the depths of the forest near Taroetoeng stands a black monument erected by the Rhenish Mission to the memory of two American missionary-explorers who were devoured there by Batak cannibals. Upon the face of the monument appear the following words in German: "Here rest the bones of the two American missionaries, Munson and Lymann, killed and eaten in the year 1834."

The weird gloom of this place, the half-suffocated murmuring of a hidden brook about the terrible deeds of other days, the penitence of Christian Bataks for the crimes of their forefathers, all combine to give this monument an eerie significance. Bataks make annual pilgrimages to the spot. They kneel before the monument and beg forgiveness. They touch it to receive its mysterious power. They bring their sick and maimed to be cured. The Rhenish Mission, of course, frowns upon all this. But the centuries-old background of animism in the history of the Bataks is not easily dispelled.

It is probable that the two American missionaries were eaten because they were admired. Batak cannibals did not eat human flesh for the sake of the vitamins, nor for revenge. They hoped by eating the flesh to absorb the spirit. To become brave, eat a brave man. To become wise, eat a philosopher. To rule over others, eat a king. Enemies were killed but not eaten unless they were respected. The most tender flesh was that of the lowland men who lived soft lives,—but the Batak epicure preferred the hard muscles of highland men for, though tough, they were good for the soul.

The brain of the father or the heart of the mother would be eaten by their children in order to acquire their virtues. The aged looked forward to being eaten upon death. It was a mark of great honor. When an old man felt that he had about completed his span and should now distribute his accumulated knowledge among his fellow men, he would, if he had the courage and strength, climb a tree and fall to his death from the branches as ripe fruit falls. The assembled villagers would then banquet upon his wise old flesh.

In addition to the spirits of dead relatives and the spirits of stones, flowers, trees, and animals, the Batak must reckon with his own spirits. He believes that within him dwells not one soul, but from three to seven.

There is, however, a principal soul upon which life depends. If it absents itself from the body, weakness and sickness result. If, in roaming afar, it gets into trouble with more powerful spirits and is destroyed, its owner dies.

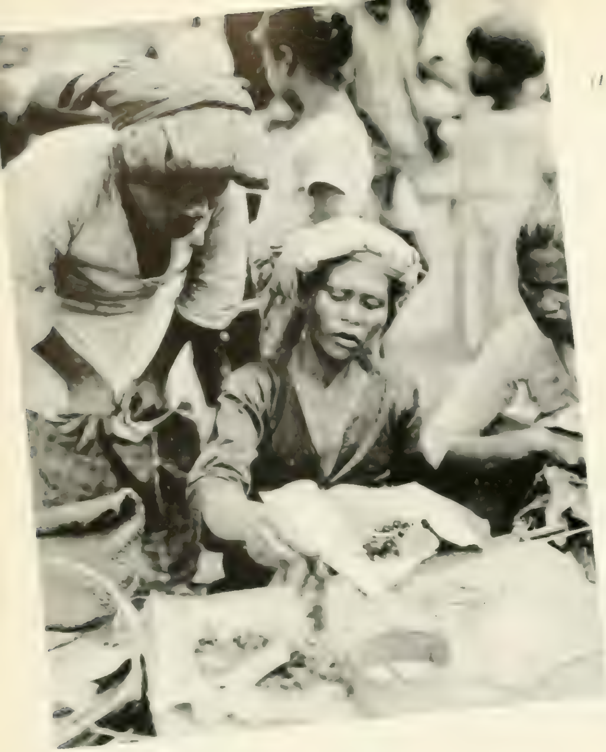
A hiding place for the soul

The chief soul, when at home, resides in the head, and great care must be used not to frighten it away. The shears of the barber terrify it. Therefore the barber in cutting the hair of a small boy, will commonly leave a patch uncut so that the soul may have a hiding place. When the boy reaches manhood, his soul has gained sufficient courage so that this precaution is unnecessary, and all the hair may be cut off.

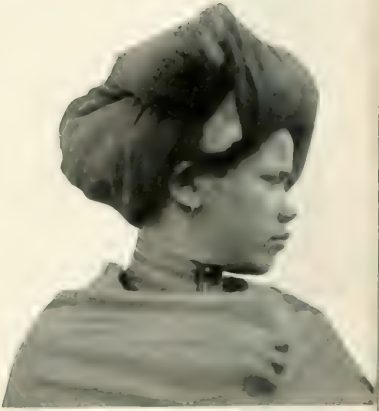
The foreign photographer is the bane of the orthodox native. The Batak believes that to be photographed shortens one's life. This is based upon the theory, held by many primitive peoples of the world, that the image received by the camera is really one's soul, which is thereby placed under the control of the photographer.

Another way to entice a man's soul, or one of his souls, out of his body is to have him give you his name. The name of a man is regarded as part of his own soul-substance. If it passes through his lips he surrenders himself with it. Young men trained in modern schools did not hesitate to tell us their names. But whenever we put the question to a man of the older generation, he would call a friend to give us the required information.

Curiously enough, with the influx of modern science, the number of spirits increases. The Batak, gazing in wonder at the sewing machine, does not doubt that there is a spirit in it. It is obvious that a very powerful god lives under the hood of a motorcar. A genie speeds back and forth through telephone wires, and another with large ears sits in the radio receiver repeating messages he hears through the air. Naturally the few young men who are so fortunate as to get an education speak scornfully of the oldsters' belief in spirits,—but they themselves are sometimes caught making furtive offerings to the unseen on the principal that "it will do no harm!"

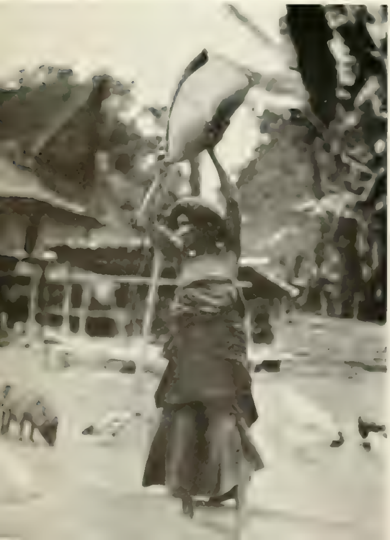


(Left) BATAKS BARGAINING in the open air market

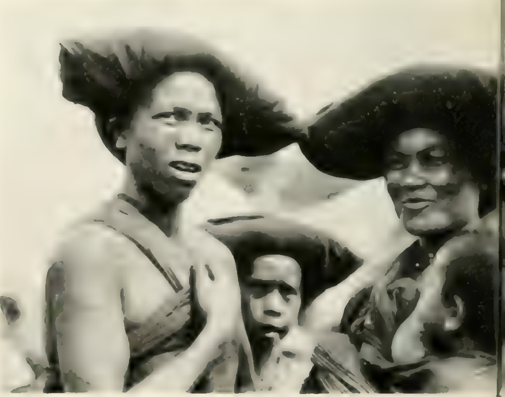


(Above) THE LARGE PILLOW-LIKE HEADDRESS worn by this Batak woman is characteristic

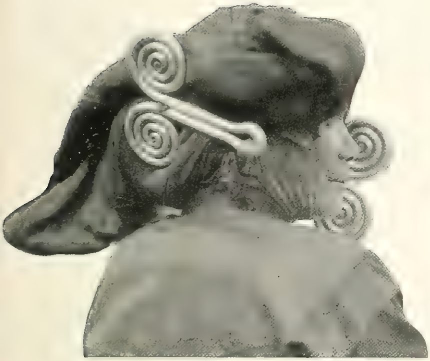
(Below) A NATIVE WOMAN of Sumatra winnowing grain. The chickens are raised for food and also for sacrifice, for their ceremonial death is believed to be pleasing to the spirits



NATIVE TYPES. The orthodox Batak believes that to be photographed shortens one's life



(Right) MOTHER AND CHILD can go where they please with the practical shoulder-sling



BATAK EARRINGS are passed through the lobe of the ear but are so heavy that they must also be fastened to the headdress

(Below) A HUSBAND kindly lifts a basket of earth to his wife's head

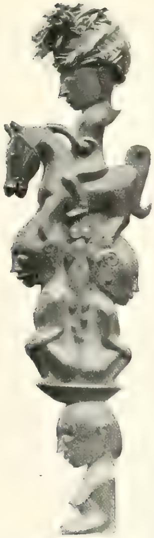
(Below) A BATAK WOMAN pauses amid the din that frequently reigns where natives gather for conversation

(Above) EACH BATAK HOUSE is expected to accommodate eight families

(Above) TREES are believed to be inhabited by spirits. When a coconut falls, it does not fall of its own accord. It is tossed down by a kindly spirit—or an evil one if it hits some villager on the head

(Left) OLD ENOUGH to carry his little brother

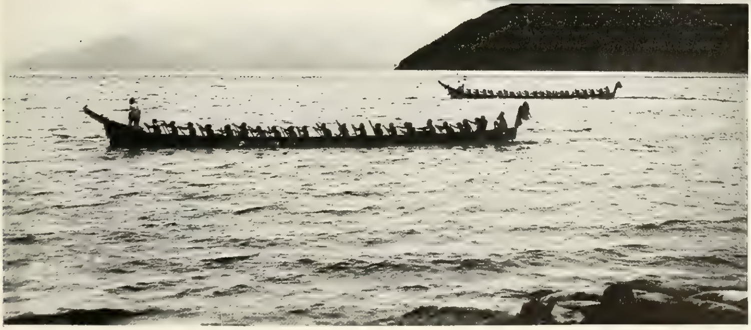
(Below) BATAK BOYS accept the new learning eagerly yet part reluctantly with the old idea of a world run by spirits. Note that English is taught the boys in this mission school. Six other Methodist Episcopal mission schools likewise teach English, and about 20 more teach the Malay language or Batak. The Government schools teach Dutch in the cities and the native tongue in the jungle



THE AUTHOR asked to be taken to the raja in a certain village. Instead of being led to the finest house, he was stopped before a large bush, bearing lovely red flowers. "He now lives here," said his guide. Having passed away, the ruler was believed to live on in the exquisite and kingly *sepatu* flower *(above)*

(Above) **AN EXAMPLE OF THE WOOD CARVING ART** in Sumatra: an elaborately carved head of a witch doctor's staff

(Below) **CANOES** on Lake Toba, a veritable lake in the sky, which lies cradled in the mountaintops. *(At right)* The paddlers in action



There's nothing "funny" about a strategic metal currently selling at over four times the price of copper and likely to have a profound effect upon our immediate future as a nation at war

STRATEGIC METALS

NUMBER 1

TIN

By FREDERICK H. POUGH

[illegible]

No longer [illegible] bandied about. For this metal now [illegible] the War Department [illegible] the broadest sense, a material essential to industry, either military or civilian, of which the domestic supply is insufficient.

Strange to say, the metal which long has been symbolic of inferiority is almost lacking in the rich resources [illegible] We have ample iron, tons on tons of coal, phosphates to fertilize the farms of the world, and gold to bury in the hills of Kentucky. But the paper-thin film of the tin we put on our cans and the tin for the toothpaste tubes of the world's [illegible] in foreign markets.

Tin is not a cheap metal, it runs about fifty cents a pound—as compared with copper at twelve cents, lead at five, and zinc at seven. But it is used economically. The tin layer on the tin can is pretty thin, and today is made even thinner. Tin is used in metal bearings, the places in a motor which support and hold the turning crankshaft. These are the most important uses of tin. Recent developments have shown that other materials, among them cadmium, can be substituted for tin in bearing alloys. But bronze and true tin foils still use much of the metal, and many of the substitutes which might be developed are found upon the strategic list themselves. [illegible] with the war it will stay so, becoming [illegible] sources and sea lanes are threatened.

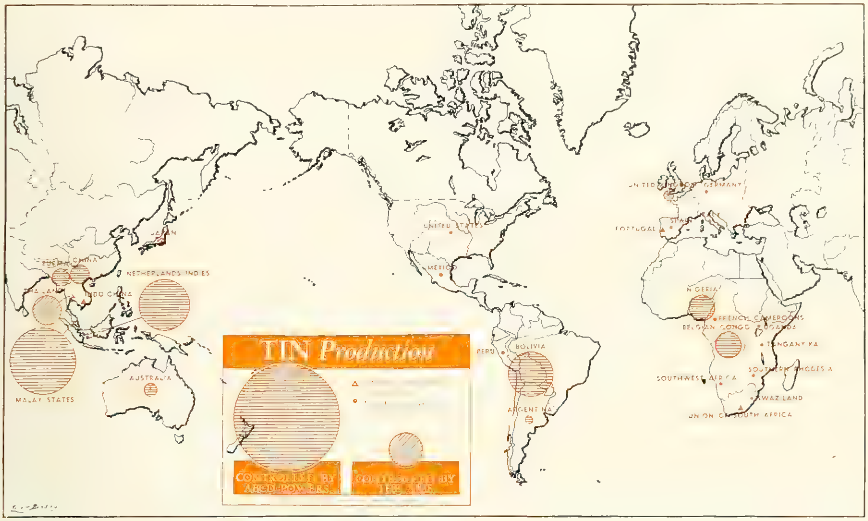
Two types of tin ore: *(left)* a knob of "stream tin" from Mexico, and, *(right)* a cluster of cassiterite crystals from a Bolivian mine

Most tin must come from ore that is newly mined, unlike some minerals that come back over and over to be re-refined, appearing again and again in new guises, like the rubber of old auto tires. Of course some tin is recovered from tin plate scrap, but gathering old cans and skinning the thin layers from them has not proved profitable. So we must rely for most of our needs upon new supplies.

Cassiterite is the only practical source of tin. Many tin minerals are known, but none except this simple oxide of tin occurs in sufficient quantity to be an ore. Most of the others are so rare that they wind up in the collector's hands rather than in the smelter. Cassiterite is found in many lands,—even, to be sure, in the United States. But of the several mines that have been developed in this country, none has produced enough ore to repay the cost or to be considered capable of supplying the smallest fraction of the nation's needs.

Cassiterite is found in veins and is also recovered by washing placer deposits of gravel. Originally, of course, most metal ores are deposited in veins. The placer deposits are formed when rock-weathering and crumbling take the place of man's ball mills and crushers. Running streams sort out the heavy ores from the lightweight impurities in the same way that jigs and Wilfley tables do. But Nature takes more time than man and works for nothing, day and night, year in, year out. From Nature's concentrates thus laid down, man gets valuable treasures which once were so scattered in the rocks that he could never have recovered them economically. So it is with most of the tin ores. Only in a few places is cassiterite mined from veins, and many of these deposits are now exhausted or nearly so, only to be worked under the stress of wartime needs.

England once supplied the tin for


TIN Production
CONTROLLED BY ABCD POWERS
CONTROLLED BY THE AXIS
JAPAN
BURMA
CHINA
NETHERLANDS INDIES
THAILAND
INDO CHINA
MALAY STATES
AUSTRALIA
UNITED STATES
MEXICO
PERU
BOLIVIA
ARGENTINA
UNITED KINGDOM
GERMANY
PORTUGAL
SPAIN
NIGERIA
FRENCH CAMEROONS
BELGIAN CONGO
UGANDA
TANGANYIKA
SOUTHERN RHODESIA
SOUTHWEST AFRICA
SWAZILAND
UNION OF SOUTH AFRICA

the Bronze Age and for the classical civilization of Rome. The mines of Cornwall are among the most important in the world, perhaps not for their actual production but for their contribution to the world's knowledge of vein mining. Cornish miners have gone to every land and carried their knowledge and their traditions to new nations. Cornish words are commonplace on the tongue of the miner and the engineer, though the tin mines of Cornwall have all but vanished. The cassiterites of Cornwall rank among the most prized specimens of their kind, and mineral collections of every land have been enriched by the showy products of these now legendary mines.

Typical waterworn gravels of cassiterite are brown, black, gray, or creamy and look little different from other pebbles. Only their extra weight makes them stand out from their fellows. Crystallized cassiterite specimens are comparatively uncommon. Cassiterite crystallizes in fine, sharp four-sided prisms, usually terminated by the sloping faces of a pyramid. Sometimes two crystals are intergrown at a definite angle. Such intergrowths are known as twins; and though many other minerals exhibit this formation, cassiterite twins are among the commoner ones in collections. The color is frequently black but may often be smoky, yellowish, or even reddish. Thin crystals are sometimes transparent. Gems have been cut from cassiterite, but such stones have little value and are of interest only to collectors.

With oxygen as the only major impurity in the usual tin ore, the recovery of the metal is not a long or difficult process. After the gravels of the vein ores of cassiterite have been concentrated, they are smelted in a furnace with the addition of carbon and some fluxes to separate out the other impurities. The almost pure tin sinks to the bottom, and after a little further treatment to separate out such things as iron, arsenic and antimony, is poured into forms.

Today, most of our tin comes from Burma, Malaya, and the Netherlands East Indies — the Oriental tin belt. The production is almost entirely from stream gravels, though in one place it is dredged from the ocean floor. Only about one-fifth comes from the vein mines of Bolivia, though a recent report of the U. S. Bureau of Mines states that the Bolivian mines probably could supply about half of our needs. These mines are of interest to the collector because they yield beautifully crystallized specimens, associated with many other uncommon minerals.

As the placers become exhausted, we can look forward to the development of more vein mines, higher prices, and more showy specimens for our museums. American tin prospects do not look very bright. Workable tin deposits may possibly be discovered in this country, but there is practically no chance of their filling our total needs. For the present the best solution of the problem is to try to create an enormous stock pile, sufficient to fill a year's demand. Then if our sources are cut off, we will be able to continue in a normal fashion for a time while substitutes and reclamation methods are perfected. Our tin future, so to speak, is far from golden.

DON'T SKIN YOUR SKUNK

He may be a big help around the garden, and if you befriend him he will make a delightful and unobtrusive pet

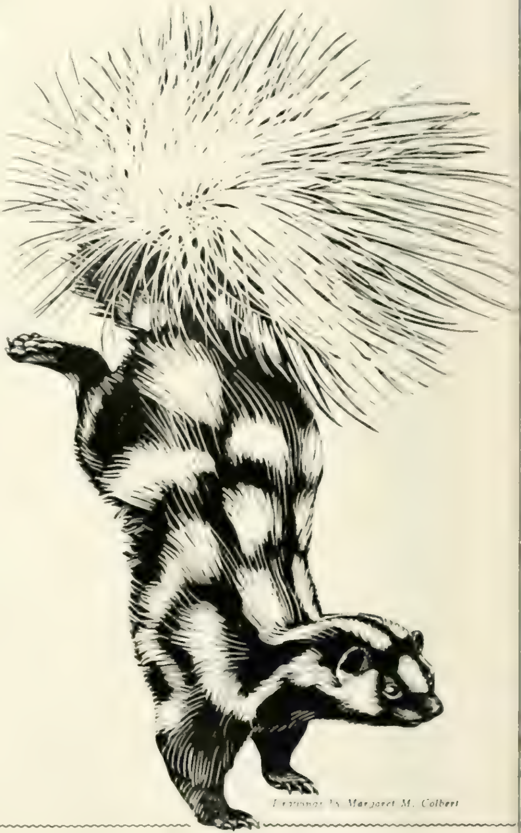
By M. R. Bogert and C. M. Bogert

"Skin your own skunk" was a proverb of the pioneers. As a proverb it is good. As advice it's bad. Don't skin your skunk! If you have one inhabiting your yard, try to get a good look at him. He may be aiding you by eating snails or insects, and he's not going to spray you unless you provoke him by actual attack. At least we believe this to be so from our experiences with the diminutive spotted skunks in California.

A considerable population of these little animals inhabited the campus of the University of California at Los Angeles, although no one was aware of their presence until they began to fall into the concrete window casings of basement windows and were unable to climb out. Usually they were cautiously removed and liberated. But one morning in early spring a call from the watchman informed the Department of Zoology that a skunk had invaded the Chemistry Building, obviously not in need of instruction, and would someone please remove it—immediately!

The little animal was a female San Diegan spotted skunk (*Spilogale gracilis microrhina*), and was captured with little more than a very mild demonstration of her abilities. Not until later was the probable reason for her exploration of these premises revealed. Apparently she had been looking for a suitable place in which to raise a family, for the morning of the third day after her capture she gave birth to two hairless, blunt-nosed, helpless offspring.

One of them failed to survive, but the other was destined to outstrip his mother in size. At birth, in spite of the lack of hair, the pattern of the adult al-



Drawings by Margaret M. Colbert

The spotted skunk is perhaps the only animal that can stand on his hands without previous training. He will do it for a dog but not for a man. In this position he stamps the ground with his front feet, advancing several inches and retreating ready was apparent, with black pigment in the skin except for pink areas where the white markings were to appear. The mother quickly overcame her initial shyness, although she never lost all of her timidity. She nursed the single remaining baby until not long after its eyes were opened. This required more than a month, and meanwhile the hair had grown rapidly. At two months the young skunk was quite active; and by the end of three months he was essentially full grown, although the excessively long hair on his tail had not reached its maximum length.

As soon as he was weaned he began to eat a variety of things that were offered to him, including fruit, insects, and dried milk. Canned dog food soon was consumed in enormous quantities. When the little skunk was hardly the size of a rat he would devour the better part of a twelve-ounce can of it in a day if given nothing else.

Playful

The youngster's behavior was not unlike that of a kitten,—if anything, he was more playful. He carried a crab apple about by the stem and dropped it from various elevated objects in the cage; he rolled it around and chased it until the stem had broken from the apple. Then, using his nose as a sort of billiard cue, he butted the remaining sphere about in a most amusing fashion. Since the bottom of the cage sloped to a center drainage hole, the apple invariably ended in the sump, where it chanced to fit securely enough to make it impossible for the skunk to remove it without spinning it around rapidly with his forepaws.

Before his eyes had opened, if he were separated from his mother, he would emit high-pitched, batlike noises; but by the time he was two months old these noises had developed into a sharp bark that was used definitely as a gesture of intimidation. His mother never barked, although she uttered a sharp squeak when something surprised her.

She could be handled, and never attempted to bite. But the youngster, perhaps because he was a male, inherited little of her gentle manner. He soon made it known that part of the cage belonged to him, a part that he was willing to defend with teeth and claws. His sharp, metallic barks were usually sufficient to warn his mother. He never threatened her with his rear offensive, despite the fact that it was well developed at a tender age—a fact which was verified under unfortunate circumstances and eventually necessitated removal of the glands.

While skunks technically are carnivores, their habits in captivity disclosed an astonishing catholicity in diet. If the skunks were hungry they would eat any fruit or vegetable, and for an entire month they subsisted without ill effects on a diet of fresh figs and avocados. Eggs they took piecemeal, shells and all, although they usually transported them without breakage to the sanctum of a box before they ate them. Our pets never refused any insect we offered them, but they subjected hairy caterpillars to a special treatment before taking them into the mouth. With astonishing dexterity the skunks rolled the caterpillars in the earth on the floor of the cage, until they had removed nearly all of the potentially irritating spines, without once puncturing the caterpillar's delicate skin. Large hairy tarantulas of the common California species were similarly treated, and did not have an opportunity to use their fang-like "pincers," which might conceivably have discouraged such rough handling.

Frustrated by an onion

The method used in removing hair from tarantulas and caterpillars was similarly employed in ludicrous attempts to remove odors from other foods. When the skunks were offered a strong-smelling white onion about the size of a golf ball, the smaller skunk immediately seized it and carried it to one corner of the cage where he spun it beneath his forefeet, rubbing it vigorously into the earth while he held his nose upward and closed his eyes. But it was to no avail. After repeated attempts, followed by hasty examinations after each, he abandoned the onion. For no apparent reason, the skunks treated snails in the same way, but devoured them after a briefer processing, crunching the shells with apparent gusto.

Fresh meat was not often available, but from time to time a gardener would kill a pocket gopher, and this inevitably led to a fight between the two skunks. Other foods they could share on occasion, but a fresh gopher was something that each sought to keep from the other. With a skunk tugging at each end, the usual result was a successful, if messy, division of the rodent. Each skunk sought a far end of the cage for unmolested enjoyment of the delicacy. Live lizards were taken too, but not with any particular relish. The skunks killed them immediately after capture with quick bites that decapitated the hapless reptiles.

For some time these skunks had their scent glands, and for a while there were no unfortunate incidents. Spotted skunks seem loath to use their one effective means of defense, and they possess a repertoire of tricks calculated to discourage the enemy before taking recourse to it. Like their striped cousins they would stamp their front feet and then swing their tail end toward the enemy, at the same time turning their heads to peer in his direction as though taking aim. If this proved to be insufficient warning they

[illegible]

Handstand

[illegible] dogs. Doubtless in the field it is used to intimidate [illegible] never observed until the perineal glands had been removed. But this was no doubt because we had considered it prudent to keep dogs away from the skunks. [illegible] has yet been observed to perform this curious feat.

The glands are essentially two syringes, with nozzles that may be thrust out through the sides of the anal opening. When the skunk goes into action, the [illegible] a distance of a few feet by the contraction of muscles surrounding them. One or both of the glands may be used, and if the first shot is not enough to put the enemy to flight, it is repeated if possible. The glands are paired holding reservoirs, so to speak, and their effectiveness lies not only in their power to stifle the enemy but to cause temporary blindness or inflammation of the nasal passages if fired at close range.

The young skunk raised in captivity was accustomed to being handled from an early age, and it is not certain just when his scent glands reached functional maturity. Probably they were ready for use at an age of six weeks. After he was about two months old neither of us handled him for a period of some three weeks. During this time he grew rapidly, and when handled again he showed some resentment and an ability that necessitated removal of the glands. When liberated in the hall of the Biology Building he took flight—something he had never done before. Upon being halted abruptly by one of us, he perhaps construed the act as an attack. A jet of nearly colorless but whitish liquid was expelled from the nozzle of one gland, and when it struck the arm of his captor it produced a cooling sensation, not unlike a drop of ether. Soon the liquid had assumed a gaseous state and pervaded the building. Doors slammed, transoms went up, and one professor, not with complete naïveté we suspect, even called an assistant on the 'phone to complain of that pipe he'd been smoking! And there were other complaints, fortunately not expressed with the effluvium that emphasized the skunk's resentment, but emphatic nevertheless.

The odoriferous ingredient in the musk has been analyzed by chemists and found to be mercaptan, a substance analogous to the alcohols and therefore one that volatilizes rapidly. Removal of the glands is one effective way of spiking the skunk's guns, and it involves a simple operation on the adults. The two [illegible] hind legs. From very young skunks a skillful operator can remove the linings of the glands painlessly by thrusting a straightened fishhook through the nozzle and hooking the barb in the lining at the back of the gland.* If carefully done, the lining may then be withdrawn through the orifice with the hook, and since it contains all the secreting cells only the muscular portion of the gland remains, and the skunk becomes a safe pet. The loss in no way impairs the skunk's normal behavior, and while the skunk may stamp his feet, the threat is an empty one.

Nocturnal

As pets, skunks have some minor disadvantages, one of which is that they are generally most active at night. A revolving drum such as that sold for chipmunks was provided for the two skunks while they were kept in a cage. The younger skunk must have "traveled" miles every night, but he also sought such [illegible] during the day. After a run in the drum he would climb out and pause to look around with what was anthropomorphically interpreted as an expression of amazement that he had "gotten nowhere."

Despite their noctural proclivities skunks make better pets than most other wild animals, chiefly because they have relatively little fear. Possession of such an effective weapon of defense has made them perhaps a little smug, a trifle oversure of themselves, —more than one skunk may have discovered with regret, which must have been brief, that an automobile or locomotive is not readily intimidated. Man is doubtless the skunk's worst enemy, particularly since the advent of the automobile. However, horned owls reeking with the unmistakable scent have been killed by collectors on numerous occasions, and it is a reasonable assumption that young skunks fall prey to those feathered predators, as well as to badgers, coyotes, and similar enemies.

Particularly in Arizona the smaller skunk is distinguished from his striped cousin by the name "hydrophobia skunk." This name seems to date from 1875 when several cases of skunk bite were reported in that state. Subsequent investigation indicated that deaths had resulted from ordinary rabies, evidently epidemic at the time. All mammals are subject to infection with rabies, and may in turn bite and infect others. Coyotes were infected in a recent epidemic in California, and a skunk, totally unused to fleeing, would certainly fall an easy victim to a rabid animal the size of a coyote. Some authorities have voiced the opinion that skunk bites may result in blood poisoning, since the skunk is a carrion feeder. Perhaps, but several people have been bitten by skunks without any serious result whatever. Aside from an occasional epidemic of rabies among skunk populations there is little to fear from them, although the remarkable variety of food they will consume sometimes causes them to make nuisances of themselves.

Skunks have been known to raid beehives, not for the honey but for the bees. From time to time they may raid a poultry house, or rob a bird's nest, but by and large their diet in a natural state is believed to

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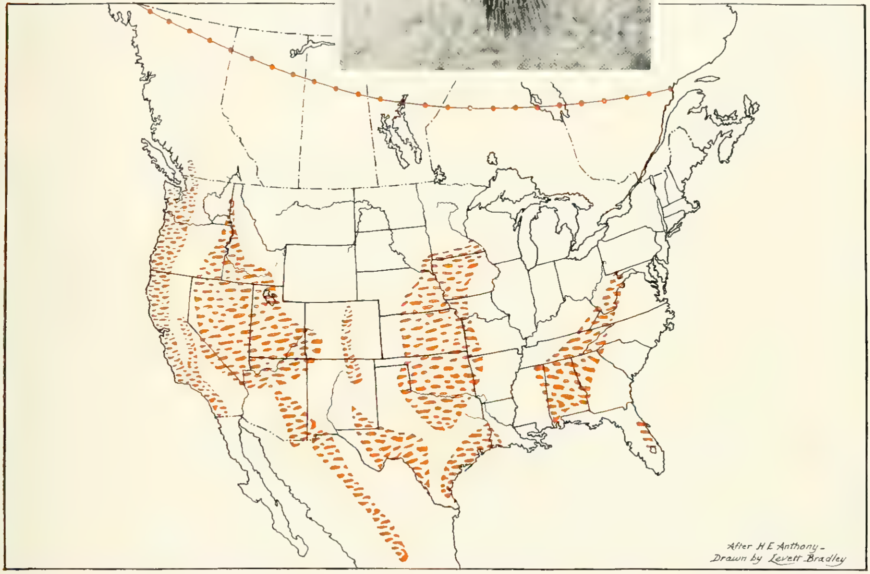
[illegible]

Little more than a handful. Even the adult spotted skunk is a gentle animal and will not use its "double-barreled gas attack" without provocation. The two scent glands are visible between the hind legs

Photo by Frank Bogert

(Below) **The stippled areas** show where you may encounter the Spotted Skunk, from sea level to mountain slopes and in chaparral or timber. Our common Striped Skunk inhabits most of North America, roughly as far north as the dotted line, but seems loath to stray from permanent fresh water. The range of the "Hog-Nosed" skunk is not shown, as it barely reaches the United States along the Mexican border



After H E Anthony — Drawn by Levett Bradley

consist largely of insects, snails, small rodents, and lizards, supplemented with berries and herbs. True, a skunk may occasionally tangle with a dog at the canine's insistence and to its owner's disgust, but on the whole the skunk is almost certainly a beneficial inhabitant when faults and virtues are balanced.

Skunk dislikes own smell

Certain it is that skunks normally shun attack and use their defense weapons only when their warnings are not heeded. Possibly their conspicuous pattern has evolved as an advertisement of their potentialities, and the handstand of the spotted skunk may be interpreted as further flaunting of its Don't-Tread-On-Me banner. It is not altruism, of course. It is self-preservation, and observations indicate that mercaptan is just as obnoxious to a skunk as it is to any other animal.

A skunk that has not been attacked is as lacking in objectionable odor as any other animal. Skunks belong to the weasel family, known on every continent except Australia, and if you have ever been close to a frightened weasel you may have had an inkling of the relationship. The odor of a weasel, to our way of thinking, is far more disagreeable than that of the [illegible] with [illegible] Though only the skunk has evolved a [illegible] defense and [illegible] a [illegible] branch of the weasel family [illegible] the weasels [illegible] would [illegible] of sable and ermine. There have been attempts to improve the social rating of the skunks by application of the name "Alaska sable," but this was inspired largely by commercial interests. Most Americans prefer the Indian name, skunk. The term "polecat" is less commonly applied and rightfully belongs to a European [illegible]

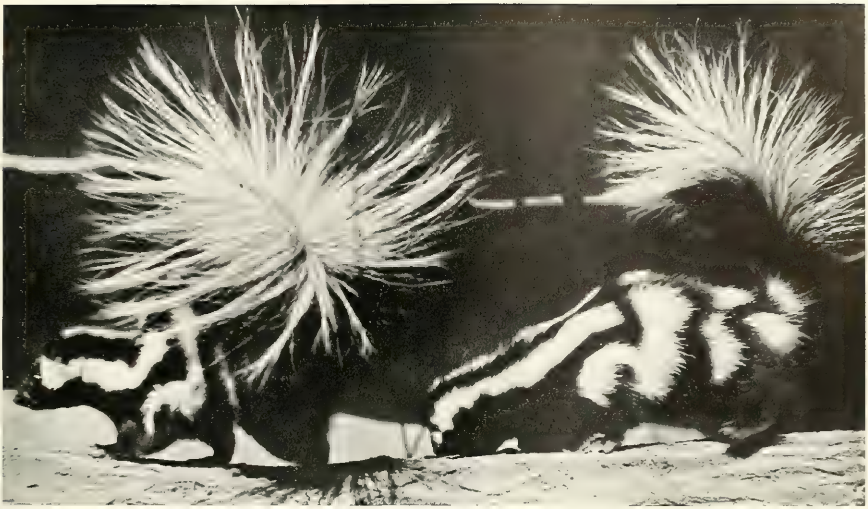
Of all the weasel family, no representatives in America are better known than the skunks. Perhaps this is because their presence is sometimes revealed without their being seen, and furthermore because they have not fled from the cities encroaching their homes. Pygmy spotted skunks are to be found in the suburbs of [illegible] American cities. Within the last year [illegible] Manhattan,—although more commonly their presence is not disclosed until some dog with a gap in his education makes the discovery, and then the whole neighborhood knows. On the Los Angeles campus the spotted skunks must have been successful in avoiding dogs, because hardly anyone except the watchmen ever saw them.

The skunk's one effective means of defense is deservedly well known, and from the skunk's point, well it may be. His reputation may be bad, but when a skunk carries a disagreeable odor it's only because an enemy has persisted in ignoring his warnings. By preference he is a pacifist, but if provocation demands he is a well-armed exponent of the gas attack.

If a skunk happens to inhabit your premises he may be an economic asset. Don't skin him—but keep your dog away from him.

MOTHER AND SON: two spotted skunks which became faculty pets in the University of California at Los Angeles. The mother "invaded" the Chemistry Building and three days later gave birth in captivity Her son would eat most of a twelve-ounce can of dog food in a day when scarcely as big as a rat

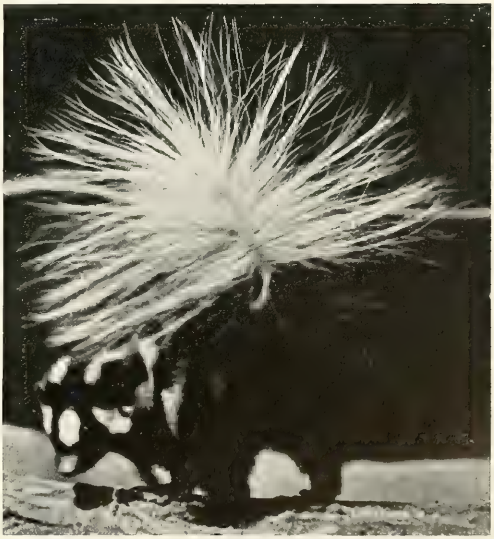
[illegible]



Photos by Frank Bogert

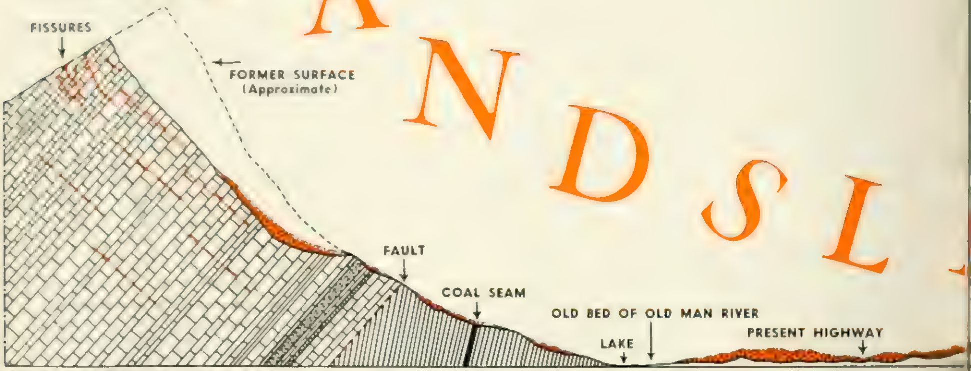
The pets never refused any insect offered them. They subjected hairy caterpillars and tarantulas to a special treatment before eating them, rolling them adeptly in the earth to remove the spines. A strong-smelling onion proved too much for the champions of scent. After subjecting the onion to the same rubbing process, with nose held high, the effort to eliminate the smell was abandoned

(Above) **Perking up for the camera:** an interesting portrait of the friendly animal whose name has become an epithet. Only the furriers have attempted to improve the social rating of the skunk—through use of the name "Alaska sable"



His upraised tail is the skunk's Don't-Tread-On-Me banner. With defensive apparatus pointed toward the enemy, he peers around to direct his aim. Skunks do not resort to their attack unless their warnings are disregarded. A skunk that has not been attacked is as free from objectionable odor as any other animal. He apparently dislikes his own smell, too

LANDSL


TURTLE MOUNTAIN
FISSURES
FORMER SURFACE (Approximate)
FAULT
COAL SEAM
OLD BED OF OLD MAN RIVER
LAKE
PRESENT HIGHWAY

[illegible]

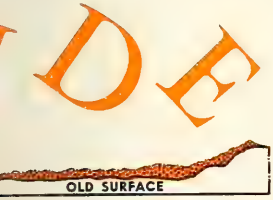
(*Above*) TURTLE MOUNTAIN, which "turned turtle." While the peaceful town at the foot slept, a mass of rock weighing 90 million tons—as much as 2000 of the world's heaviest battleships—rushed down upon it at express-train speed. The drawing above shows the joint cracks which weakened the mountain, and the mass of rock which fell. It is interesting to note that the most recent large landslide in the Western Hemisphere, which fell on the town of Huarás in Peru a few weeks ago, also happened early in the morning when the populace was asleep

The story of what happened early one morning when a town in the Canadian Rockies was caught in the path of one of the largest avalanches in history

By H. E. VOKES

Assistant Curator of Invertebrate Paleontology, The American Museum of Natural History

Most of Nature's agents work slowly, so slowly that a thousand years in the shaping of the earth are like the ticking of the second hand on her clock. But she can also gather her forces over a long period and release them suddenly. Then the result is apt to be dismaying, as it was when the peaceful village of Frank, Alberta, was caught in the path of one of the largest landslides of history. While most of the village slept, a mass of rock weighing 90 million tons, as much as 2000 of the heaviest battleships afloat, crashed down upon it, covering a distance of two and one-half miles at an estimated speed of 90 miles per hour.



Late in the evening of April 28, 1903, Chapman, one of the nineteen men on the night shift of the Frank Coal Mine, paused before entering the tunnel. He looked around into the quiet valley of the Old Man River and up the steep slope to the crest of Turtle Mountain towering nearly 3000 feet directly above. The many vertical limestone cliffs seemed almost to overhang the mine entrance.

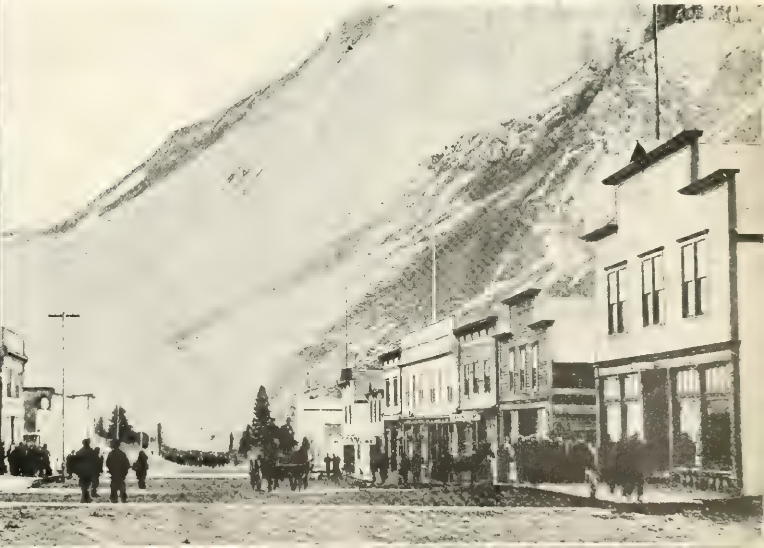
MacKenzie joined him and suggested that they go into the mine. It was too cold to stay outside. A few days before the weather had been unseasonably warm. In Calgary the temperature had risen to 74 degrees. The roaring waters of Old Man River in the valley below gave eloquent testimony that a great amount of snow had melted from the mountain. But tonight it was cold enough in all conscience. The thermometer might fall to zero before morning.

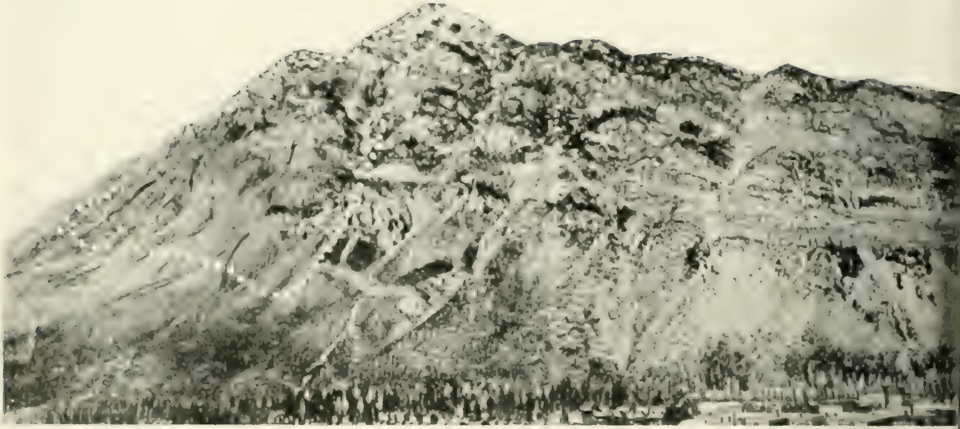
King Frost was preparing to take over the night shift in Turtle Mountain and on a scale out of all proportion to the human crew in the mine.

Chapman hesitated before going below,—for seven months there had been slight earth shocks in the mine, like the shuddering of a ship struck by a great wave. Deep in the tunnel there seemed to be a general squeeze in the ground. The timbers appeared to be under an excessive strain. Rockfalls in the mine chambers were increasingly frequent. The coal had begun "to mine itself." Some of the men had become worried and had gone on up to Blairmore to work.

Most of the lights in the town of Frank had died out and cold darkness was settling over the valley when Chapman entered the mine. The sec-

NINETEEN men were trapped in a coal mine beneath the avalanche and were believed lost. However, they dug their way out and are seen emerging just beyond the last house on the left in the remarkable photograph below. The wagon is carrying one of the men who was injured. The cloud of dust at the top is caused by falling rock





(*Above*) THE MOUNTAIN that fell on a town. The dotted line indicates the portion which fell--a mass half a mile wide and 400 to 500 feet thick in the center

LYING JUST NORTH of Glacier National Park on one of the main east-west routes through the Rockies of Canada, the scene of the great avalanche at Frank, Alberta, is easily visited by the tourist

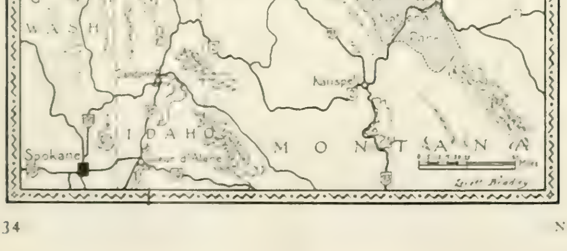
tion where the night crew were working on the 28th was a chamber where the roof was no more than 300 feet below the surface.

At four o'clock in the morning an engineer backed his freight engine up to the tipple at the mouth of the mine for a load of coal. The load that Turtle Mountain had in readiness for him was not a few cars of coal but a mass of limestone a half a mile square and 400 or 500 feet thick in the center. The engineer was startled by a sharp noise on the mountain. Instinctively he immediately threw his throttle to full speed ahead. In that instant he saw the whole side of the mountain tear loose with a roar like steam escaping under high pressure.

His train ran clear, but looking back he was horrified to see the men who were working at the entrance of the mine overtaken and buried by the slide. The avalanche roared down into the valley, wiping out the southwestern half of the town. So fast was its rush that, broken into innumerable fragments, the mass plowed through the bed of Old Man River carrying both water and river bottom with it and hurled itself up the opposite side of the valley to a height of 400 feet.

Down in the town, Mr. McLean who kept a boardinghouse, happened to be up. He heard the noise and rushed to the door in time to see the slide shoot past him only a few feet away. The avalanche was so instantaneous that he thought that an eruption had blown out the base of the mountain directly in front of him.

A Mr. Warrington, who was sleeping in one of the cottages destroyed, was awakened by a noise which he thought to be caused by hail. Realizing that it might be something more serious, he jumped from bed. The house began to shake, and the next thing he knew he was 40 feet from where the house had stood, his bed



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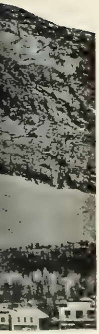

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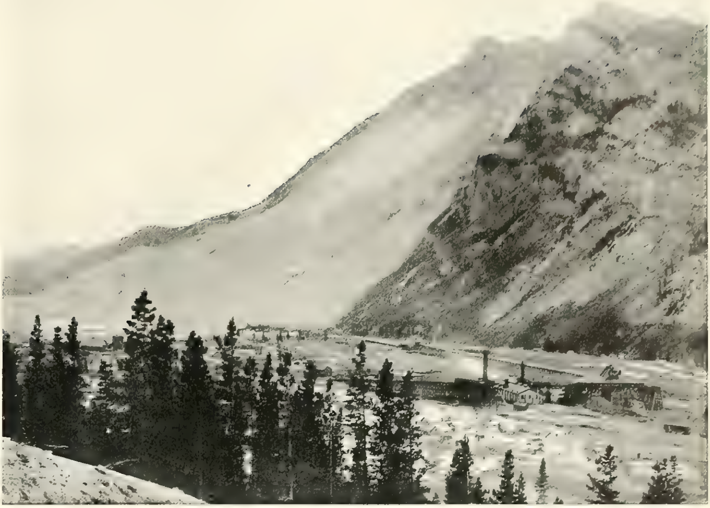


Courtesy of the Bureau of Geology and Topography, Ottawa, Canada

(*Above*) A RECENT photograph of the scene. The first noise of the avalanche sounded like a hailstorm. Then the full tumult split the air in a gigantic roar. A few persons actually witnessed the catastrophe. A boardinghouse keeper saw the slide shoot past him only a few feet away, and the engineer of a coal train ran his locomotive out of the path just in time

Photos by the author

THE MODERN ROAD crosses the devastated area, as shown at left and above. The rock looks so freshly broken that one can hardly believe the disaster occurred almost 39 years ago—especially when one sees rocks occasionally fall from the face of the mountain above [illegible] Morris—nineteen in all? Where the [illegible] smashed in their chamber beneath the [illegible] in the rock wilderness.

Three hundred feet below the surface, the first signs the miners had [illegible] great blast of air through their tunnel. It blew all the trap and safety doors open and threw men and horses off their feet. The mouth of the tunnel was at once blocked by broken rock.

Deeper in the mine, coal suddenly started to break loose and shower down the manways. The men working near by became frightened and started to escape down the ladder. As Chapman raced down he heard a scream of agony and looked up to see MacKenzie caught in a cross-passage which was partly filled with crushed and fallen rock. Though lacking tools, Chapman sprang into the danger zone and with his bare hands tore the rocks from MacKenzie and carried him to the tunnel below. All the way down he was battered by falling coal but was saved from serious injury by his miner's helmet.

The tunnel entrance was completely blocked, and the [illegible] volunteered to try to escape through one of the airways, but soon returned with the news that bad gas pockets [illegible] also been closed by the slide. They tried to estimate from this how thick the avalanche must be above their heads. Should they attempt to dig out through the debris over the tunnel, or try to drive a shaft to the surface farther back in the mine where the surface slope was deeper and the avalanche probably less thick?

After some discussion it was decided to attempt the latter. But the tools were at the other end of the tunnel, a mile from the entrance. Volunteers agreed to attempt the hazardous passage back through the tunnel, braving the falling rocks, to secure these tools and some necessary timbers. Four thousand feet from the entrance, the upper wall of a large [illegible] eighteen feet, and they had difficulty getting around the obstruction to the tools. It was almost seven in the morning when they returned, and the way [illegible] them it would not be possible to go back for more equipment.

All morning and into the afternoon the men worked in shifts driving the shaft towards the surface and timbering it with logs removed from the tunnel. Gas began to collect in the upraise, but driven on by desperation they persisted until about five in the afternoon, when they suddenly broke through to be greeted with a shower of rocks. Luckily all but one of the men escaped this new danger, and he was not seriously injured. The rock fragments fell for only a few minutes and a cautious investigation showed that the way was open to the surface. They came out almost on Dominion Street, the main thoroughfare of Frank.

Once above ground, Chapman looked up at the mountain. Its eastern face was entirely different from when he last saw it, and the valley he had known so well was now a chaos of rock fragments. He did not realize it, but he was looking at the largest known rockslide that had occurred on this continent and one of the largest that had occurred in historical time. It covered over one square mile and had an average depth of about 45 feet.

What caused this great mass to break loose from the mountain? And why had it fallen at this time? The answer to the first question can be found in the structure of the mountain itself. Turtle Mountain is composed of a great thickness of Paleozoic limestone, thrust up over a series of younger, relatively soft Cretaceous sandstone and shales, with some rather thick seams of soft coal. The slope of the upper part of the mountain averages over 45 degrees, and in the part which broke away, it may even have reached 75 degrees. This [illegible] extensive series of joint cracks, developed at right angles to the bedding. [illegible] a much lower angle than does the slope of the mountain itself, forming [illegible] broken loose, will slide into the valley.

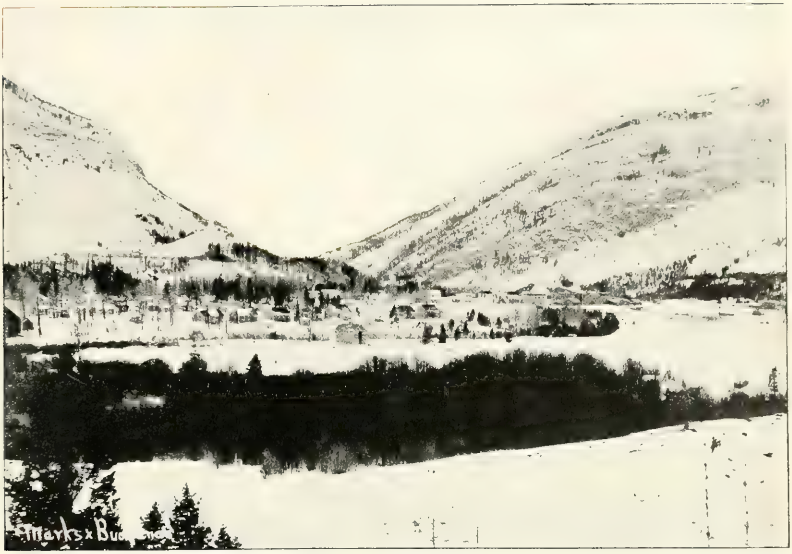
[illegible] tate the avalanche on April 29th, 1903. The mine was right at the foot of the mountain, and in the light of the [illegible] which the miners had been noticing for over a period of seven months, it seems [illegible] ments were settling and giving under [illegible] tain. It is probable that the shocks were communicated to the limestone [illegible]

But the unseasonable weather determined the hour at which the calamity occurred. The unusual warmth of the past few days caused extensive melting of the winter snows, and this melted water had penetrated the open joint cracks. Then on the 28th there was a sharp change to cold weather, and the thermometer fell to zero in Frank on the morning of the slide. The water in the joint cracks froze. As it froze it expanded, tearing loose the last supports which held the mass in place, freeing it to hurtle down into the valley as one great avalanche of destruction.

Easily reached, since it lies in Crowsnest Pass, which is one of the most traveled east-west routes through the Rocky Mountains of Canada, the Frank slide is one of the most remarkable geologic phenomena that the writer has seen. Some of the accompanying photographs, taken in 1939, show the slide as it appears today. The rocks look so freshly broken that it is hard to believe that this disaster occurred almost 39 years ago.

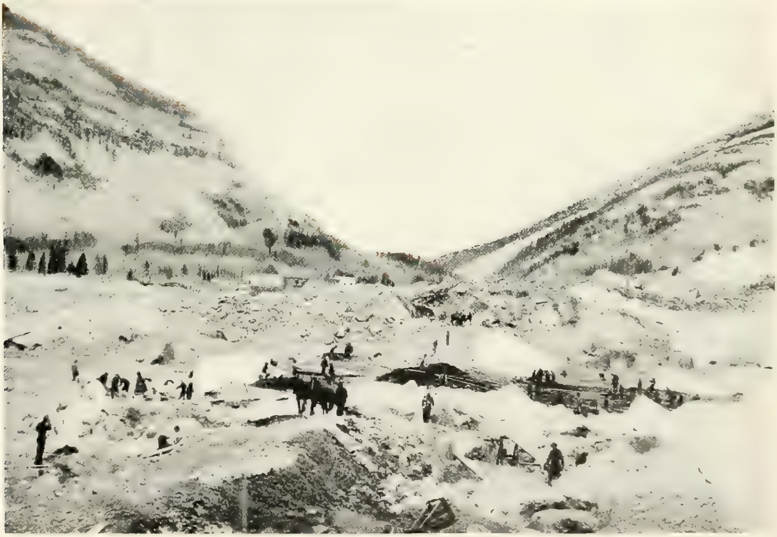
People still live in the town of Frank, though the structure and disposition of Turtle Mountain are the same as before. A geologic examination of the mountain in 1910 showed that new fissures were developing behind the steep slope. One cannot say it won't happen again. You drive across the chaos of broken rocks, and a feeling of apprehension comes over you. You glance warily up at the mountain. Sometimes when you look, a rock will fall from the cliff and come tumbling down. You look and you wonder whether Nature is spending her energies in her slow, normal way, or whether she is gathering them for another gigantic cataclysm.

BEFORE



AFTER

TRANQUILLITY TURNED INTO CHAOS—two photographs taken from approximately the same spot. From the entire western section of the town, where fully 70 persons had been living, there were less than half a dozen survivors. An area of over one square mile was covered by the avalanche

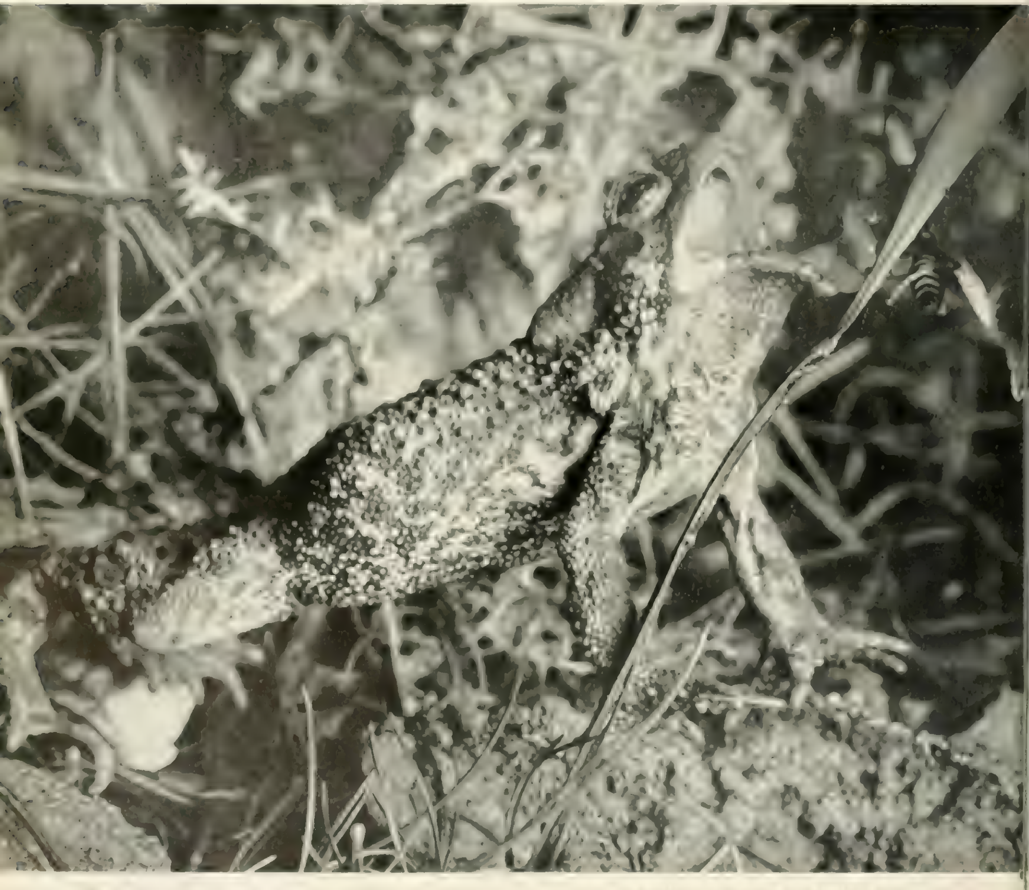


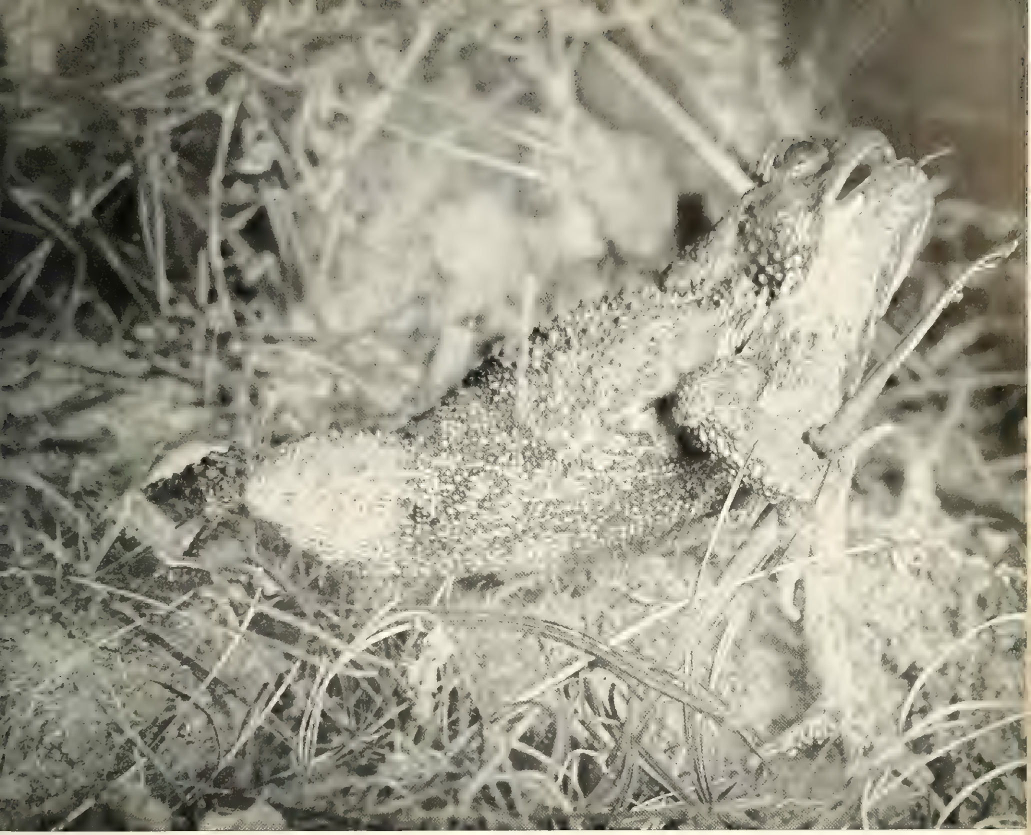
FAST FEEDER

The superspeed camera catches Mr. Toad making a "boarding-house reach": the first photographs showing a toad in the combined act of leaping and capturing its food with its tongue

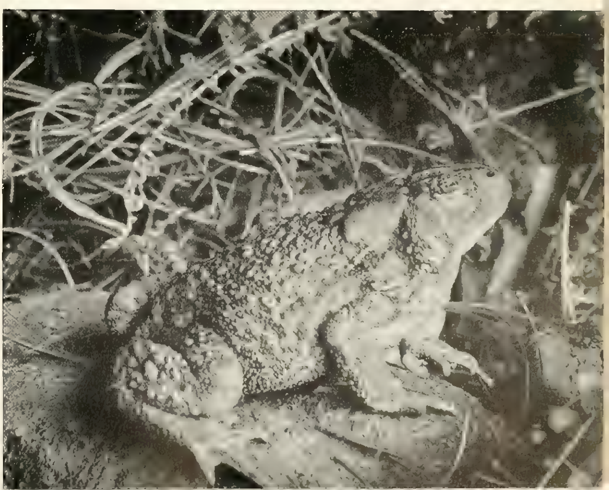
By HENRY B. KANE

1 MIDAIR in his leap toward the wasp, the toad darts out his sticky tongue. The tongue is hinged in front instead of at the back like ours



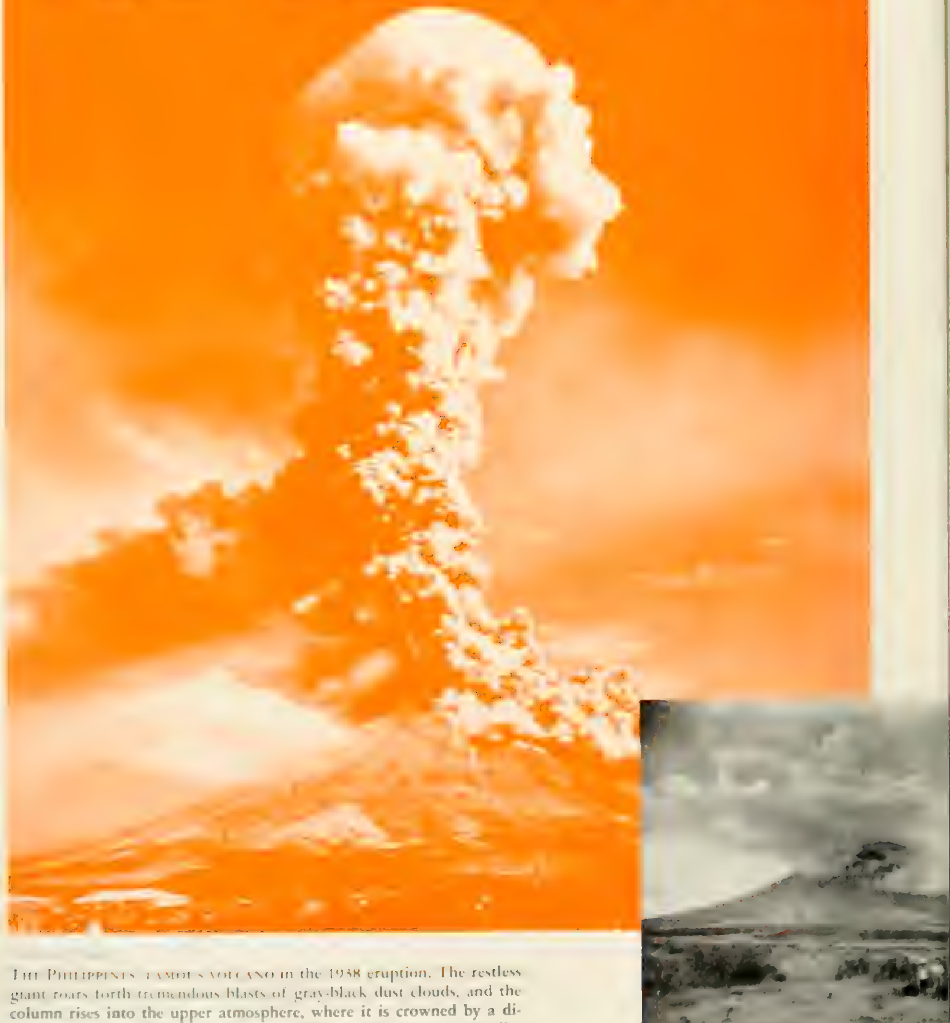


2 The quick wasp is not quick enough to escape the lightning-like flick of the tongue, and the toad's mouth closes on the insect like a trap



3 From the toad's pained expression it might be supposed that the wasp has fought back, but this probably would not bother the toad. Humans sometimes close their eyes when swallowing medicine; the toad always does

RESTLESS GIANT OF THE PHILIPPINES



The Philippines' famous volcano in the 1938 eruption. The restless giant roars forth tremendous blasts of gray-black dust clouds, and the column rises into the upper atmosphere, where it is crowned by a diaphanous curtain of frozen white vapor. The dust may travel 50 miles

In its quiet moments Mayon Volcano is a thing of beauty. In eruption it provides a spectacle almost indescribably terrible and magnificent. Yet the natives till the fertile fields right to its threatening slopes

By HUGO MILLER*

When Manila newspapers run the headline, "THE MAYON IS ERUPTING," the Filipinos take new thought of their famous volcano, a restless giant in which they may ordinarily have felt a sort of pride. Immediately Malacañan, the seat of government in Manila, makes its channeled inquiry to provincial officials. The Red Cross gets in touch with the situation. From their fields around the capital, army airplanes, both Philippine and United States, fly 200 miles south to the Bicol Peninsula on which Mayon is located. The planes of the commercial air line are booked up, and the Manila Railroad Company puts extra coaches on its southern line to take care of the civilian sight-seers who may wish to tear themselves away from the metropolis and risk beholding so awesome a spectacle. For Mayon Volcano does not frequently erupt itself into the headlines. Its last interval was ten years, and its latest outburst occurred in June, 1938.

If you ever have the opportunity, don't fail to see Mayon Volcano, even if it is quiescent, for it is the most symmetrical mountain in the world, and its slopes are unblemished by any secondary cones.

Mayon Volcano stands apart. From the sea it rises in a perfect curve some 8000 feet above the waves that lap its base. From the shallow Bicol Valley, it slopes upward with equal symmetry out of a pattern of rice dikes. Its lowest slopes are green with spreading banana plants and plumed coconut trees, interspersed with open spaces where rice is cultivated. The middle slopes are deeply scarred with ravines that lift the eye upward through grass-covered ground to the barren and austere cone itself, silhouetted against the clear sky, or through soft, white clouds that gradually disappear into the blue. There is nothing soft about Mayon Volcano. It remains aloof and detached—a perfect picture of cataclysmic strength held in leash against the humans who dwell in towns and villages and work in the fields at its base. From its crater, a thin plume of vapor rises as a reminder that this is no dead shell but a living form that may break the leash when it so wills.

Even during its quiet moods, Mayon is a satisfying and worth-while sight. Now that the railroad has been completed, it is possible to leave the Paco Station in Manila at seven in the morning and be in Legaspi, the seaport at the base of Mayon Volcano, by nightfall. Buses make regular trips over the 40 miles of road around the base of the volcano, or automobiles may be hired for the trip. The nearest approach on the main road is about three miles from the top of the cone. On a side road, one can ride through virgin forests past a resthouse to an altitude of some 5000 feet, and it is from this place that ascents to the crater are made when the mountain is quiescent. Here a gully, bottomed by an ancient flow of hard lava, rises some 3000 feet straight up to the sulphur fumes that

(Left) A **SPANISH GRANDEE** and a beautiful young woman recently come from Spain were on this historic spot when the church was buried under an avalanche of rock. She was in the church, he at the door watching her at her devotions. When the avalanche of incandescent rocks fell, the lady was buried, while the grandee, helpless to aid her, was spared. During this eruption in 1814, 1200 people in the municipality of Cagsaua lost their lives. The ashes of several hundred lie under the rocks in the nave of the church. *(Photo by Hugo Miller)*

(Below) **THE CONE OF MAYON** viewed through a window of the church that it destroyed

Photo by Signal Corps, Philippine Army

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*The author wishes to acknowledge the help of the Reverend Father Miguel Selga, S. J., Director of the Philippine Weather Bureau and Vulcanologist, with whom he discussed the scientific and historic points contained in this article.

[illegible]

However, the [illegible] in a straight line from the top of the cone, that the best view can be had of an eruption. This vantage point is called "Kilometer Nine." To get the whole sweep of the volcano one must go by launch to San Miguel Island, twelve miles from the cone, from which point the mountain can be seen through green coconut palms, across the blue waters of the strait.

To those scientifically minded, I recommend an interview with the Reverend Father Miguel Selga, S. J., Director of the Philippine Weather Bureau, the vulcanologist who [illegible] Mayon and finds answers to the what's and why's of its volcanism and who advises the authorities about moving the people on its upper slopes down to refugee camps. In Legaspi one can find people who have ascended to its top and know the volcano as a friend.

In the early stages of an eruption, Mayon Volcano is as periodic as "Old Faithful" in Yellowstone National Park. "When will the next eruption be?" you ask, on your way to Kilometer Nine.

"You will have time to make it," is the reply. "She is erupting every four hours, so the next show will be about noontime."

And then it comes

Mayon in eruption has none of the soft and sprightly beauty which rises and falls in white, hissing surges from the crater of Old Faithful. Mayon never loses the solid dignity of its perfection nor fails to express its power. In an eruption its grand complacency changes to magnificent awe-inspiring action. It roars itself into the stratosphere in tremendous blasts of gray-black dust that seem to cast over the land the shadow of the volcano's might. It snarls—not with the irritation of a caged tiger but rather with the boredom of a restless cat in its lair—a snarl at inaction, and perhaps a warning. Even in eruption, Mayon remains detached and superior.

Suddenly, from the crater, a small dust column emerges. Is this the scheduled paroxysm?

The gray column rises and plumes off with the wind. Higher and higher the column rises, its base forming a clean-cut cylinder over the cone. Then there is an outburst—as if the top of an immense iron teakettle had been blown off by steam escaping from [illegible] boiling water—and almost in a second, a great blast of gray-black dust rises a mile or more into the atmosphere. A roar comes down from the mountain. Above and outside the furious black surge, a volley of rocks can be discerned by the naked eye, as it is thrown into the clear. The outbursts come one after another, and the black dust column swirls and puffs higher and higher into the air. With each outburst there is a roar and a volley of stones, whose impact on the side of the volcano can be heard.

After the first blast, the base of the smoke column changes. Spurts of light gray dust seem to shoot from beneath it down the side of the cone, like rays in a star sapphire. But these soon develop into a confused mass of billowing black clouds, a mass that swirls halfway down the mountainside and at the same time rises to join the dust column above the crater.

Soon the dust column penetrates the upper atmosphere, its top covered by a diaphanous kerchief of frozen white vapor. The sunlight reflected on the dust column varies the color effect. Sometimes it appears as black as coal, often gray as smoke from a factory chimney, and again it is a shimmering white beneath the dead-white kerchief that so sharply separates it from the blue of the sky.

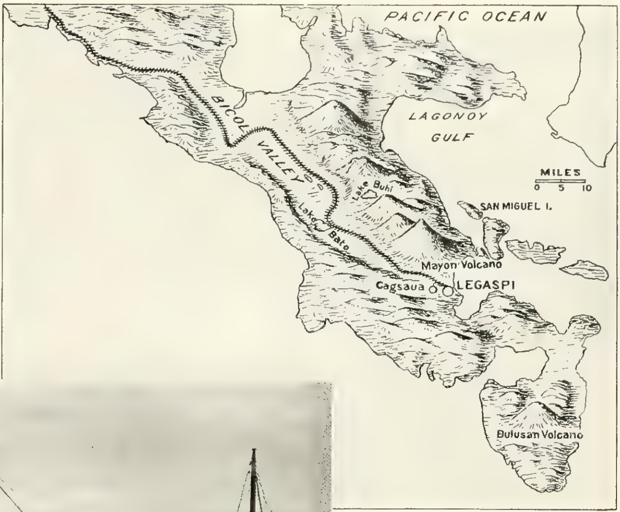
In the meantime, the dust rising from the mountainside is carried out and away by the wind and begins to settle on the slopes. Gradually, as the paroxysms lose their force and frequency and finally cease, the column itself enlarges and slowly disappears, the dust floating away into the stratosphere and the atmosphere or descending to the earth. There are evidences of dust 50 miles from the cone of Mayon and, on the lee side, the dust gives a gray coating to vegetation even 25 miles away from the crater. It seems to dry up banana leaves and the foliage of other delicate plants, but otherwise no harm is done. In fact, the accumulation of dust in the soil has made the lower slopes of Mayon Volcano the fertile lands that they are.

After dark

Night turns on the lights of Mayon and makes it incandescent. In the dark a quiet outpouring of white-hot rocks can be clearly seen. From the crater, the headlong path of each is marked, like the fall of a meteor, by a head of reddish-white light and a constellation of sparks broken off as the rock bounces along. As the slope of the volcano flattens out, the progress of the rocks is slowed and they advance in jerks and spurts, pushed on by the force of the ejected material behind them which finally collects in great mounds.

Hence, Mayon in silent eruption at night is aglow with rays of lambent reddish-white light, sparkling,

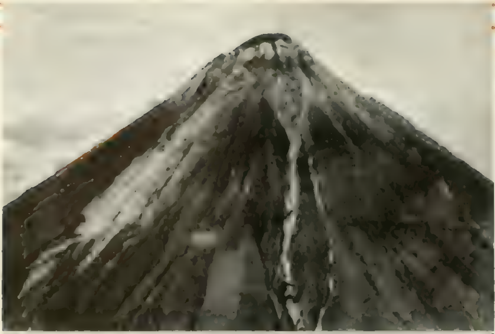
Mayon is one of a row of six volcanic cones at the southern extremity of the island of Luzon, approximately 200 miles southeast of Manila. Four of the cones are "dead"; of the remaining two, Mayon is the more active


PACIFIC OCEAN
BICOL VALLEY
LAGONOY GULF
MILES
0 5 10
Lake Buhi
SAN MIGUEL I.
Lake Bato
Mayon Volcano
Cagsaua
LEGASPI
Bulusan Volcano

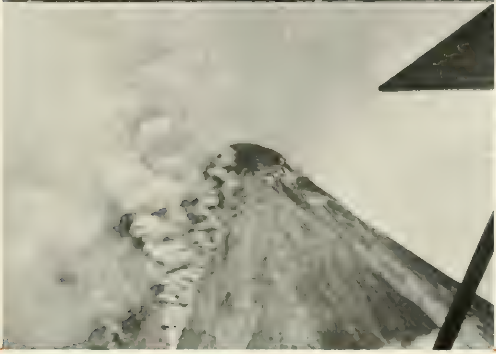
Photos by Hugo Miller

Here in a port under the shadow of Mayon, outrigger sailboats drop anchor with cargoes from the islands and coastal villages. It is in this region that the Japanese have attempted to establish one of their beach-heads

A lake in a lake. In prehistoric times a volcano died, leaving a depression which filled with water to form Lake Taal, twelve miles across. Today the crater of Taal Volcano lies in the island shown at left, and in that crater is another lake. In this island crater, pools of colored water used to boil. Then in 1911 Taal erupted one night in a spectacular paroxysm and snuffed out over 1000 lives. Since then the water in the crater has been cold and quiet



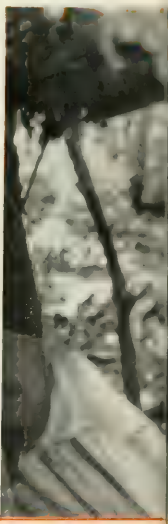
Hot rocks rolling out of the crater produce the spurts of dust or gas visible on the left-hand flank of Mayon in this aerial photograph. From this side the crater is concealed by a semicircular wall left by a previous eruption. Note the gulleys down which the ejected incandescent rocks roll when the volcano goes into action

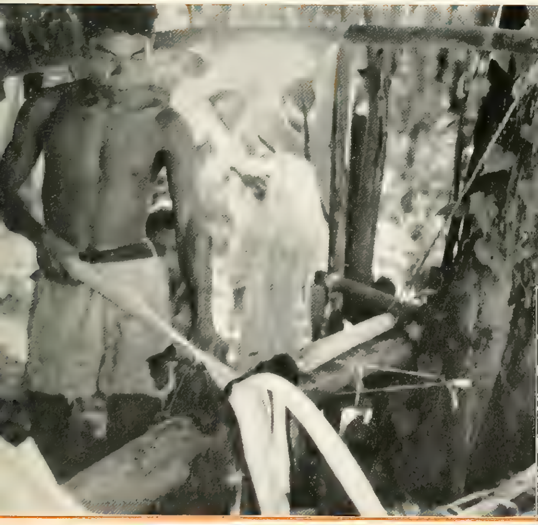


(Left) Mayon is now in "silent" eruption. White-hot rocks spill out of the crater and rush down the gulleys, emitting superheated steam and other gases

(Right) As the eruption becomes paroxysmal, great quantities of rock roll down Mayon's gulleys and disintegrate into great billows that rise in a confused mass to join the gaseous column over the crater

In spite of Mayon's threat, work goes on in the shadow of the famous volcano. Here a peasant is cultivating his rice fields with a wooden harrow pulled by a water buffalo. In the distance, trash is being burned and rain clouds veil the slopes





The rich volcanic soil of the region, aided by heavy rainfall, yields the world's best rope fiber. A kind of banana plant called abacá is the source of the world-famous Manila rope. The native at left is stripping the fiber from the leafstalk. Four children who know Mayon Volcano as a near neighbor are shown below beside bundles of newly stripped abacá fiber hung out to dry. In the background can be seen the banana-like plant that yields these fibers

Photos by Hugo Miller

flickering, wavering, and gliding down the mountain in pools of phosphorescent luminousness. The glow is reflected and radiated from a thick cloud of water vapor and gases which rises from the disintegrating materials. The full moon that brightly floods and penetrates the whole landscape remains unnoticed, for its illumination seems to be concentrated in the streams of light on the mountain.

A shower of incandescent rocks

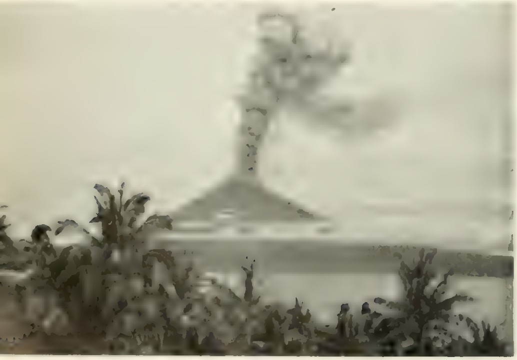
From the top of this slow-creeping radiance one suddenly feels a glare. A great brightness rises from the crater. Then with a roar, hundreds of incandescent rocks spill out or flash up a mile or two and, curving, descend like falling stars upon the side of the cone. For a few moments the mountaintop is a blaze of brightness. Now down the side of the mountain roll black billows behind tongues of light from incandescent rocks that spurt out ahead. Above the crater itself, an oval of brilliant luster pierces the pitch-blackness of the Stygian cloud, and from this resplendent jaw of darkness the incandescent rocks flare, fall, and disappear into the blackness below. It is as if the devil's munition dump had suddenly been touched off.

The impression of Mayon's gray magnificence in daylight and its radiant transplendency at night remain a vivid memory.

Apparently no burning gases flame out of the crater of Mayon. Its luminousness is entirely derived from incandescent material, just as light from an incandescent globe is produced without flame. The incandescent material is white-hot rock. Volcanic ejecta that are high in silica, as from Mount Pelée, Martinique, have comparatively high fusion points and solidify rapidly at the temperature of the atmosphere. In a siliceous lava flow, the outer crust solidifies rapidly; but under it the mass remains plastic and continues to advance, producing a sort of rolling and churning motion. Ultimately it hardens to form a slaggy lava known as "scoria." The material from Mayon Volcano contains about 50 per cent silica, and the solidifying point of the mass is comparatively high. As the top of the column of molten material reaches Mayon's crater, it is already a solid but nevertheless white-hot rock. The pressure of the gases within this solidified mass is much greater than the pressure of the atmosphere. For this reason, as the rocks come to the surface, they not only carry with them dust scraped off from the inside walls of the crater but they themselves are partly disintegrated into dust by the escaping gases. The latter fact explains the noiseless column of dust that rises out of the crater as the first sign of paroxysmal eruption. However, the disintegration is far from being complete. A solid cap forms over the crater and escaping gases accumulate under

IN THE EARLY STAGES of an eruption, Mayon is as periodic as Old Faithful. You may be told that she is erupting every four hours. Then suddenly a small dust cloud rises

YOU CORRECTLY SUSPECT that a paroxysm is beginning. Higher and higher the column rises, clear-cut and ominous above the layer of atmospheric clouds



***(Left)* Now the smoke-column thickens and towers higher. Bursts of gray gas glide down the slopes of the cone like the rays of a star sapphire**

[illegible]

it, finally blowing off with a loud roar. The cap is then broken into dust and rocks, some of which are as large as a small house.

Whether they be thrown merely over the side of the crater or hurled a mile or two into the air, they all fall, finally, onto the side of the cone. There they gather in gullies that have been washed into the soft sides of the mountain by tropical rainstorms. As the rocks roll down these gullies, they continue to disintegrate through the force of the escaping gases and give off spurts of gray dust and billows of black dust clouds which, carried by the gases, rise to join the dust column over the crater. Mayon is thus nothing more or less than a slag heap, 8000 feet high, made of some lava flows but mostly of dust, sand, cinders, and rocks of all sizes, including ones that cooled before they could disintegrate. This is how vulcanologists explain the eruption of Mayon Volcano and its perfect cone. The nature of the gases imprisoned in the incandescent rock is not definitely known. But from the cloud of water vapor that rises from the ejected material, it is obvious that a great quantity of superheated steam is present.

The quiet life below

People who live in the shadow of a volcano are in general a phlegmatic lot, and so the day's work goes on whether Mayon be quiescent or in eruption.

The water buffalo must be guided as he pulls the plow and the harrow over the rice fields. The seed beds must be seeded, the young seedlings thrust into the mud that is confined by the rice dikes, and, when ripe, the rice must be harvested.

The volcanic sides of Mayon and the heavy rainfall of this region developed a kind of banana plant that is indigenous to the Philippines. Its native name is *abacá.* While its fruit is not edible, the leafstalks contain a fiber which, extracted and cured, enters the commerce of the world as "Manila hemp."* This is the best of rope fibers. Not long ago, a steamer that had been sunk during World War I was raised. In its cargo were bales of Manila hemp so little affected by 20 years under salt water that it was still strong enough for rope. Abacá "just grows" at the base of Mayon Volcano, but Nature requires that a great deal of human effort be expended in stripping it from the leafstalks. The stalks must be cut down, the petioles broken away from one another and pulled beneath a knife which scrapes off the pulp and leaves the long, strong fiber.

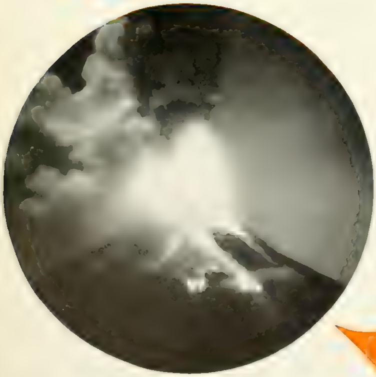
In many a house in the villages, the click of shuttles draws one's attention to handlooms. Women are busy weaving Manila hemp into a coarse open cloth called

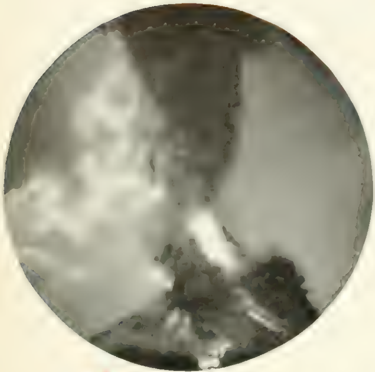
Presently the mountain is enveloped in thick swirling clouds, and the main column rises to the upper atmosphere

Photo by Hugo Miller

Manila fiber for rope has been designated as a strategic material, because it is still virtually indispensable to the Navy.

AND INTO THE NIGHT





1 MAYON VOLCANO in silent eruption as evening draws near holds in store an unforgettable spectacle

2 AGLOW WITH RAYS of lambent reddish white light, Mayon Volcano holds every spectator spellbound when viewed under the full moon, as at right. This exceptional photograph was taken with an exposure of about one hour and therefore shows an accumulation of glowing streams not normally visible at any one moment. But there is much more motion of light than is shown in this picture, for a constellation of sparks showers off as each rock bounces along

3 TEN MINUTES AFTER THE LAST EXPOSURE, the author's camera caught Mayon at the beginning of a paroxysmal eruption. A column of incandescent rock has risen in the crater and its light is reflected on a plume of vapor and dust

4 THE FIRST EXPLOSION of the paroxysmal eruption is shown at lower left, in an exposure of about one minute. The cap of incandescent rock is blown to pieces by the gas accumulated under it. Then, with a roar, hundreds of incandescent rocks spill out or rocket thousands of feet into the air, to descend like shooting stars. After the noise of each gas outburst, these stones can be heard falling onto the side of the mountain. This exposure was one minute

5 *(Upper left)* AMID THE GLARE, the tracks of incandescent rocks can be seen, and a column of black smoke rises from the side of the cone. For a few moments the mountaintop is ablaze with brightness. Then black billows build up from the descending tongues of light, and, above the crater itself, an oval of brilliant lustre pierces the pitchy blackness of the cloud

sinamay, and here and there is to be heard the "pin-ok-pok" of wooden paddles beating the sinamay into a crude, linen-like cloth. From the spindly coconut palms the nuts must be gathered for another native industry—the "harvesting" of copra. The split nuts yield the half rounds of white meat, which are dried over fires. Automobile trucks and lumbering carts drawn by slow, plodding water buffaloes, collect these products and bring them to the seaports, where the hemp is baled and the copra sacked. Both are loaded on steamers under the quiet, white plume or the rumbling smoke column of Mayon. From islands and from coast villages, sharp bowed, outriggered proas fold their sails in these harbors along the volcano's shore line.

Earlier eruptions

Except for the people who live in the higher villages, and especially near the larger gullies down which the incandescent rocks tumble, an eruption of Mayon Volcano causes no change in the routine of the day's work. And yet Mayon's list of casualties is fairly high. The Filipino peasant is a stoic. Whatever fear he may have of Mayon, he successfully hides, although he well knows that as late as 1897—the year before the Americans came—400 people perished in the town of Libog. The survivors reported that people fell dead or died where they sat. No autopsies were performed. The victims were quickly buried in one common grave. But among the survivors were those whose skins were badly burned, probably by a sudden rush of superheated steam down the side of the mountain. And the air may have been poisoned with carbon monoxide and other gases, intensely hot. Not far from Legaspi one sees mute testimony of the destructive force of Mayon—the upper half of the facade and the top walls of the nave of a stone church that was buried under an overwhelming avalanche of rocks. This eruption of 1814 took the lives of some 1200 people in the municipality of Cagsaua. A dramatic story is told about a Spanish grandee and a beautiful young woman recently come from Spain. She was in the church, he at the door watching her at her devotions. Hence, when the avalanche of incandescent rock burst from the mountain and spurted down the slope, he was able to escape while she was buried. The ashes of several hundred people lie under the rocks in the nave of the church.

Strange as it may seem, most of the damage from Mayon within historic times has resulted from water. During the Philippine typhoons, or hurricanes, which frequently pass over or near Mayon, the volcano acts as a condenser. Avalanches of water, mud, and rocks rush down the bare slopes of the mountain and flood the plains below. Small brooks turn to currents 50 feet wide and rivers that normally can be forded become raging torrents 200 feet across. Roads, plants, and towns are destroyed by the swift currents or buried under sand and mud and rocks many yards deep. The loss of human life and of domestic animals is very high. In 1875, 1500 people were killed, and the loss of animals and crops could not be calculated.

Mayon Volcano, for all its austere and magnificent beauty, is the Number One potential Philippine calamity-maker. Father Selga watches it carefully, not for any increase in the volume of vapors and the depth of subterranean sounds, but mainly for earthquakes centering in the volcano which may give an indication of dangerous strain and activity in the reservoir of molten material. Father Selga served as adviser to Governor-General Stimson and President Quezon respectively in the eruptions of 1928 and 1938. Over 25,000 people were moved from their towns to evacuation sites in 1928; and about 10,000 were transferred from their *barrios* to safer places in the eruption of 1938. The work was hard, the responsibility was great, but his happiness is greater because not a single life was lost.

How restless, Mayon?

Is any volcano really dead? Thirty miles from Manila, in prehistoric times, a volcano disappeared and left in its place a lake and in the lake the volcanic island of Taal. In 1911, Taal snuffed out over 1000 lives in a violent explosion, and since then it has been popularly considered among the dead volcanoes. But is it only plugged?

Is any quiescent volcano to be trusted? I decided contrariwise when I was taking a picture three miles from the crater of Mayon and saw a sudden burst of gray dust rush down at me in a gully that had previously not been occupied by any tongue of sudden death.

Since Mayon stands by the sea, some people are afraid that the ocean may flow into it, causing steam that will blow the mountain to pieces in a cataclysmic eruption, such as Krakatao's in 1883 and Taal's in 1911. And yet, peasants will continue to raise rice and make copra and strip Manila hemp on the base of Mayon Volcano; and I for one, if it again goes into action, will hasten there to see it. Unless Mayon is blown to pieces by accident, its activity will probably lessen, and the mountain may finally fall in on itself. However, this change will cover geological years, and in the meantime there will be many opportunities to see Mayon in eruption.

Adventures of
AN ARTIST-EXPLORER

The varied career of James L. Clark, sculptor, executive, and big-game hunter on three continents, is one of the most exciting in the annals of the American Museum

By D. R. Barton

T[illegible] without end, the jealously guarded privilege of the male animal.

In sharp contrast to such profoundly academic and agreeably tobaccoy dis[illegible] James [illegible] Clark. Here you are simultaneously impressed by the individuality and by the tasteful arrangement of its appointments—the zebraskin screen, the dark, subdued, peculiarly hushed tone of the furniture, the restraint in distribution of numerous bronzes and other objets d'art. The sensation is quite like that of having somehow wandered into the reception room of a Fifth Avenue dealer in fine art. As Doctor Clark removes his black-ribboned pince-nez and rises from the desk chair one fully expects to find him in a morning coat complete with striped trousers and beige spats. But he has no need of such sartorial exuberance. His conservatively groomed appearance jibes perfectly with the New England broad *a* of his speech, the gestures of his well-kept, aesthetic hands. Watching these hands in repose, it is difficult to imagine them as once having been cruelly tortured by bandits or as possessing one of the best and probably the itchiest trigger fingers in the entire Museum.

But then, it is even more difficult to imagine their smooth-cheeked owner sporting a fierce set of unkempt whiskers that would put a Russian peasant to shame, and riding an equally shaggy yak over the bleak Mongolian desert. Such accomplishments are nonetheless an integral part of his reputation as an internationally famous hunter of big game on three continents. Indeed, in a moment of youthful recklessness he planted his feet firmly on the road to fame and fortune by hiring himself out [illegible] who risked his own life to protect others from the wild beasts of Africa.

Yet, for all that, the first impression [illegible] Doctor Clark is certainly a dealer in fine art by virtue of his function as ringmaster of the greatest animal art show on earth—the habitat groups at the American Museum of Natural History. And he is himself an artist. There stands in Sagamore Hill, historic home of Theodore Roosevelt, a bronze statue of a rhino, which was one of the immortal President's most cherished possessions. It is the work of James L. Clark. Doctor Clark has about 30 other bronzes to his credit in addition to innumerable mounted animals, all, of course, faithfully sculptured in clay after the revolutionary method taught him by Carl Akeley. Unquestionably Akeley is the founder of modern taxidermy but James L. Clark is its major prophet. His patient skill as a teacher, combined with his executive ability, has enabled him to impart this artistic technique to others and thus develop one of the finest staffs of craftsmen ever to be assembled anywhere—the Museum's Department of Arts, Preparation, and Installation, which he has supervised [illegible].

James L. Clark

Tip

Though he left school for good at the age of fifteen* James Clark rose to become temporary vice-director of one of the world's outstanding educational institutions while still in his forties. Born and raised in Rhode Island he visited New York occasionally during childhood and was even then familiar with the building wherein he was later to make so illustrious a name. In those days anyone strolling along 77th Street who chanced to glance in the direction of the Museum would be confronted by the ominously looming posterior of a mounted ex-circus elephant named Tip, which was clearly and unabashedly visible through a large window. This struck Jimmy as amusing but a sad commentary on the alertness of the Museum's exhibition planners. He resolved then and there that if ever he had anything to do with the institution, Tip would be withdrawn to some position where his rear would not be so flagrantly exposed. As a matter of fact, this maneuver was effected without Jimmy's assistance, but not many years intervened between his first sight of Tip and the day that he was brought down from Providence by Museum Director Harmon C. Bumpus.

The latter, himself a Providence man, had been seeking a young sculptor among those studying in the Rhode Island School of Design. Jimmy was chosen from the lot although he was only eighteen at the time and labored under the added handicap of having to study at night, since he was compelled by day to earn a meager living in the designing room of the Gorham Silver Company.

One morning a few months after Jimmy Clark arrived at the Museum a stranger approached his workbench.

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*[illegible] of [illegible] West Virginia Wesleyan [illegible]

This man had the rough-hewn Lincolnesque countenance we are accustomed to associate with the pioneer, and he was, in fact, a pioneer in his own right for locked within his brain lay the secrets of an unprecedented method of mounting animals based on the ingenious use of that most fluent and delicately expressive of all sculptural materials—water clay.

Clark, of course, had no notion that this stranger was Carl Akeley. He simply went about his business as unselfconsciously as possible under the man's relentless scrutiny, until Akeley introduced himself. They conversed for a while; then Clark settled down to await developments. These came with dazzling rapidity and with such far-reaching effect as to prescribe the broad outlines of Jimmy Clark's career for the next 35 years.

Akeley left the young sculptor for Bumpus's office. "I have found the man at last," he told the Director. "If you will send this chap Clark to me at the Field Museum, I'll teach him all I know. I've seen him work, and he's the only one I'd be willing to trust with my method."

Carl Akeley kept his promise. During the two months' apprenticeship at Chicago he passed on the secret of his technique, and though Clark was soon back in New York applying what he had learned, their relationship as master and closest disciple was to continue throughout Akeley's life. And perhaps even at this early date it was foreordained that the disciple's major work would lie in the fulfillment of the master's greatest vision.

It must not be supposed, however, that Clark was a mere instrument in Akeley's hands. His function may better be visualized as a sort of forceful and highly gifted junior partner who contributed not only a superior executive ability but much in the way of creative innovations and improvements.

One morning Clark picked up the phone to find himself connected with a prominent actress who explained that she was deeply grieved to learn that her favorite riding horse had just died and she hoped the hide could be fitted over a lifelike mannequin sculptured by Doctor Clark in the usual Museum manner.

"Can you do that?"

"Certainly," he replied, "whatever can be done with a wild animal can be done with a horse." He wondered, however, if he might make so bold as to inquire what she wanted to—uh—do with the mannequin once she got it in her home.

"Why," the lady exclaimed sweetly, "what an absurd question! Naturally, I want to ride it."

There was a brief pause. "Then," said Doctor Clark, "in that case I'm afraid I'll have to do a little figuring. May I call you back?"

Here was a problem. Museum animals are, of course, not stuffed. They are simply hollow shells of papiér-mâché, so light that a school girl could shoulder a zebra with ease. But she couldn't *ride* it very long without inducing partition or at best a decided sway-back. However, there is obviously considerable mechanical talent required of a man charged with building Museum groups, and it is a qualification which Doctor Clark possesses in abundance. Once he had put his mind to work on the problem he soon came up with an idea for bracing the body walls of a mounted specimen so that it could support an astonishing amount of weight without sacrificing its own easy portability. This innovation was tried out on the actress's horse with complete success. So far as Doctor Clark knows she still bestrides the mannequin on imaginary canters about her boudoir. But the important result of this episode is that all the Museum's larger animals can now serve as riding horses so far as load capacity is concerned. For Doctor Clark saw at once that the bracing of the animal's rib case for greater durability was a valuable extension of Akeley's method.

This was the only one of the several improvements the disciple has made which was suggested via the vagaries of the theatrical mind. The others evolved over the years from his patient and never-ending study of animal anatomy and behavior.

Paradoxically, the disciple had to resign from the Museum before he gained any appreciable firsthand knowledge of animals. About six years after Bumpus imported Jimmy Clark from the Rhode Island School of Design, that young man entered the Director's office and asked for a leave of absence. He reported that he had a chance to go to Africa with an outside expedition and he felt that here was the opportunity of a lifetime and that any man who wanted to make a profession of animal sculpture would be a fool to pass it up. Bumpus considered for a moment and then asked Jimmy if he valued the opportunity sufficiently to resign. It was a critical moment. Jimmy bit his lip, wavered, but finally

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[illegible] and knocked at Clark's door. Rather [illegible] projected hunting trip to the Dark Continent [illegible] the renowned A. Radclyffe Dugmore to go out there in advance and get big game pictures. Clark knew Dugmore [illegible] and begged to go along. The [illegible] refused at first, even though Clark asked only his keep in the field. Then Jimmy stressed the dangers of photographing wild game in action. "You'll need a bodyguard," he pleaded, "someone to keep a gun on the animal while you're busy with the camera." Dugmore admitted the wisdom of this arrangement and relented.

When they debarked at Mombasa, the trusty bodyguard hastily sought a secluded area to try out the rifle he had just purchased. "I couldn't hit a tomato can at three feet," he says recollecting the incident, "but, of course, I didn't mention that to Dugmore."

So off they went into the field the cameraman blissfully ignorant that he had placed his life in the hands of a mere tyro—a 23-year-old sculptor who knew little of guns and absolutely nothing of African wildlife. But it was a case of sink or swim with Jimmy Clark, and he gained experience of both in a hair-raising "cram" course that few men could have survived.

By prearrangement Clark never fired until he heard the click of the camera's shutter. And when you are faced by a charging rhino, bearing down on you at express train speed—that takes nerve. Squinting along the barrel of his gun, Jimmy would see the whole landscape blotted out by this huge, black, onrushing mass. Nor is there any guarantee that a bullet will turn the brutes. Many a time Clark had brought them down stone dead a few precious feet short of their goal. But on one particular occasion the rhino kept coming even after both barrels had been discharged.

"His momentum," writes Doctor Clark, "carried him by as I turned to face him, but he instantly wheeled and rushed at me. Again I side-stepped and fired [my revolver] into his face, and again he went by with a rush and wheeled. A real battle was on, and for a few quick moments it was [illegible] [illegible] stepped and pulled the trigger until six shots from my revolver were fired into his head, but with no more effect than to make him shake his head as if a bee had stung him. At the last rush, with my revolver empty, I dashed clear to one side . . . "

Eventually, the creature galloped away, apparently in fine fettle despite a deep spear wound and eight bullets buried in various parts of its body.

"On another occasion," Doctor Clark continues, "when Dugmore had left Africa and I was protecting Cherrie Kearton on what was probably the first motion-picture expedition that ever made cinema records of African game, I had a demonstration of how suddenly and unexpectedly these blundering beasts can appear. . . . Every one of us turned to run [from the rhinos], for they had come so quickly that we had no time to think. But after two or three yards I realized that I couldn't outrun them, and furthermore, the tree nearest which we were was already sheltering the two *askaris*, the water boy, and Kearton. The result was that I turned to tree. But by then the two ungainly animals were down in the dry stream bed and I could see only the tips of their horns and the tops of their backs. There was no target, and I had to wait. In a moment they were climbing the bank, and I pulled one trigger. To my horror the gun did not go off! I pulled again! another misfire! And by now both those rhinos were within five yards of me. I turned and ran, passing close beside the tree. I remember seeing Kearton kneeling and aiming.

" 'Fire, Kearton!' I cried as I passed and I heard his gun go off. One of the rhinos was close behind me, I knew. How close I could not tell, but hoping to throw him off his charge I changed my course to the right, to bring me behind the tree, past which, by this time, I had gone about three or four yards. As I turned I was reloading, and out of the corner of my eye I saw a fearful situation. Kearton had fired at the rhino that was after me while the tree obscured the other. The rhino he hit hesitated for just the fraction of a second that made my get-away possible and then came on, while Kearton, thinking to dodge him, darted around the tree and almost ran squarely on to the other's horn. He saw his danger in time and stopped just as the rhino went past not more than three feet away. Then, to their everlasting credit, the two Masai spearmen went into action. One was facing each way, and as the rhinos went past the tree each thrust with his spear. The attack was too painful and sudden to be resisted, and by great good fortune, the two rhinos parted, one going in each direction."

The Africa of 1909 was still in that frontier stage of a country's development wherein meteoric rises are the order of the day and the wonderful legend of Cinderella may be realized overnight. On this first visit, Clark remained only fourteen months. But he emerged a made man.

His luck held through all the hairbreadth escapes from charging animals, and he leaped from one job to another as nimbly as a lumberjack in a log jam. Almost the moment the Kearton expedition ended, a messenger reached Clark's camp from none other than Carl Akeley, who had landed in Africa with the mighty T. R. himself. They were outfitting an expedition to collect a group of four elephants for the American Museum, and Akeley invited Clark to join the personnel.

Thus the tenderfoot bodyguard who eight months before couldn't hit a tomato can at three feet had become a sought-after veteran of the field. Professional African hunters working with the Akeley-Roosevelt expedition were aghast when told how he had covered onrushing rhinos for the photographer. Said one of them, "Why, man, there isn't money enough in the world to pay me to do that. I *know* those animals." Clark had done it merely for his keep. Yet there was an additional reward. He had accomplished his sworn purpose of gaining a firsthand knowledge of wild animals. Henceforward he meant to make that knowledge yield dividends.

Perhaps the happiest moments on this safari were the fireside pipe talks with Carl Akeley in the long evenings following grueling days on the trail. It was then that the master opened his heart to the young disciple and revealed his dream of a great, million dollar African Hall, conceived as a memorial to the teeming game that inevitably would vanish from the no-longer-Dark continent. Even then Akeley saw the elephants which they were engaged in collecting as only the nucleus in the finished Hall. He envisioned other expeditions, many of them. He wished to return again and again, for he was a man who had pledged his life to Africa.

Clark learned other things from Akeley on this trip—practical things that hastened his growing mastery of taxidermy. And when, toward the close of the expedition, Jimmy joined Kermit Roosevelt's safari, the President's son asked him to take complete charge of mounting his many trophies and those of his illustrious father, in addition to collections for the American Museum and the National Museum in Washington. On the basis of this large order, Clark was able to open his own studio in New York, and soon through his African connections he built up a large clientele of sportsmen with whom he hunted and studied big game in Canada and the American west. Akeley himself used the studio to work on his own specimens after they were shipped to these shores. While thus engaged the two men continued to exchange ideas for the construction of Akeley's dream hall and further strengthened the bond between them.

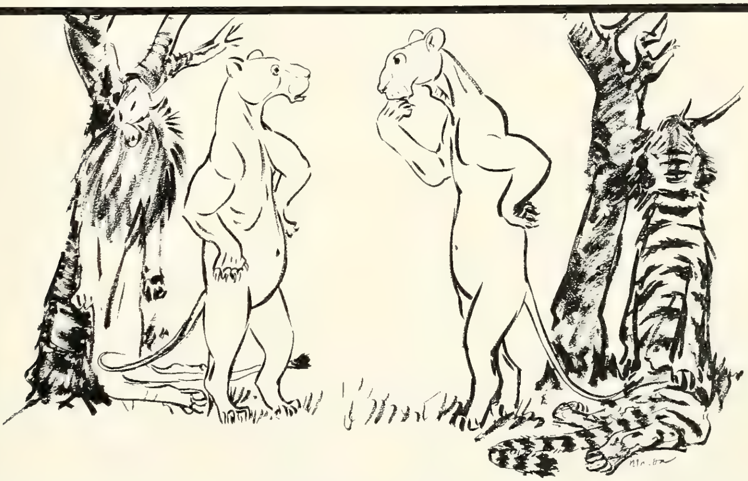
About this time, Akeley began to manufacture his famous moving picture camera, which he had been more or less forced to invent because of the awkwardness of existing models under the complex demands of wildlife photography. When America entered World War I, Clark volunteered for the Naval Air Service but was turned down on account of age. Meanwhile, government orders for the Akeley camera came pouring in and it fell his lot to take over the reins of the company. Clark was manager, vice-president, and then president of the Akeley Company until 1928 when he resigned. During this same period, the Clark studio became the foremost taxidermy establishment in the country and, in 1923, at Akeley's request, Clark was invited to return to the Museum to reorganize and take charge of its Department of Preparation. The master wanted all executive affairs left in the hands of his disciple so that his own time could be devoted without stint to the enormous job of planning, collecting for, and securing financial support of, the splendid edifice that is known today as the Akeley African Hall.

Not that Clark was confined entirely to his desk. In November 1923, he returned to Africa with his wife, spending six weeks in the field. Five years later he went out again to collect the lion group, and on another trip in 1931 his goal was the Giant Eland

Continued on page 62

BROTHERS UNDER THE SKIN

By JOHN ERIC HILL *Drawn by* G. FREDERICK MASON



WHEN seen alive in their native haunts or in the zoo or circus, lions and tigers appear so different that it is often supposed they are equally distinct "under the skin." But on the contrary, the internal structures of these two great cats show remarkable similarity. The inexperienced observer could not tell them apart, and in many cases a specialist can hardly distinguish them.

The lion appears more massive, especially in the males with well-developed manes, and the tuft at the end of the tail makes that member appear shorter. In truth, however, the proportions of body and tail are about the same in both species, and the tiger reaches a slightly greater size, especially as indicated by weight. The tiger usually has a more convex facial profile (indicated in the cartoon) and its lower jaw has a concave lower margin, while that of the lion rocks on a flat surface.

In the few recorded encounters between lion and tiger, the latter appears to have had the best of the argument which, cat-like, was no bout of rules and gloves.

Captive animals of the two species have mated and successfully produced hybrid young tiglons, one of which is on exhibition in the Central Park Zoo, New York City. These hybrid offspring indicate the relatively close relationship between lion and tiger.

A HOUSE OF BUBBLES

By Edwin Way Teale

Photographs by the author

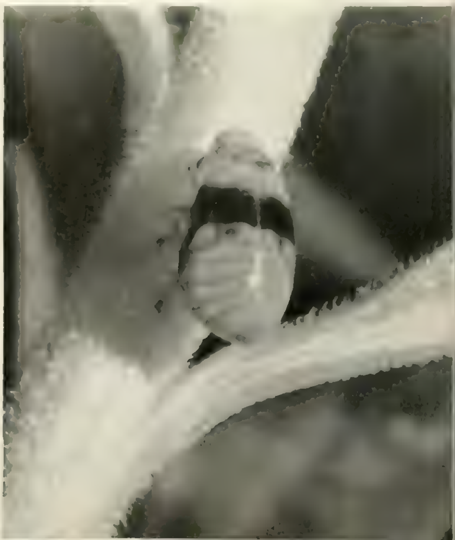
Each spring little masses of froth that resemble the beaten white of an egg appear mysteriously on weeds and grass stems. From April to July in northern states, these masses have been called "frog spit" or "cuckoo spit" under the misapprehension that they are voided by tree frogs and cuckoos. Southern negroes believe horseflies hatch from the bubbles.

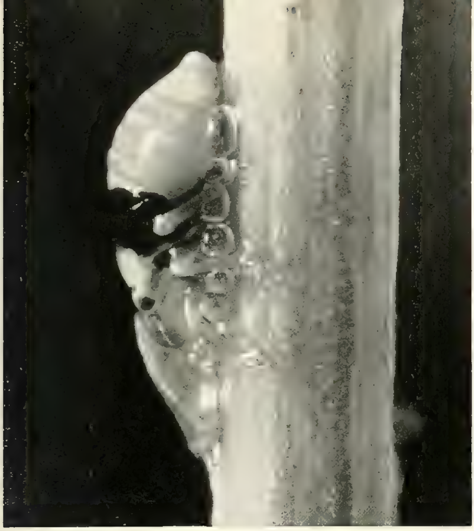
In reality, each little mass of froth is the home of a tiny [illegible] a quarter of an inch or less in length. Among the more than 600,000 existing species of insects, these spittle-insects, or froghoppers, seem possibly to be the only ones that produce bubble dwellings in which they live, apparently protected from enemies and the heat of the sun. Under their roofs of froth, they drink sap, molt from time to time, and finally, when full grown, develop wings and appear among the herbage as inconspicuous gray or brown insects. From a distance you might think you were looking at an oat kernel—until you were startled to discover its prodigious jumping ability. During the process of growing up, a froghopper may build several of its unique houses of foam. Among scientists, the insects are known as the Cercopidae.

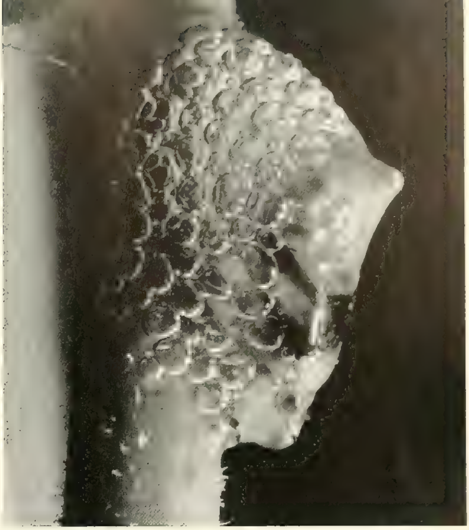
Excess sap from the plant on which the froghopper is feeding is the building material out of which it constructs its dwellings. One cercopid, found on the island of Madagascar, is virtually a living spigot. It draws off such quantities of sap that four or five of the insects are reported to be able to fill a quart jar in the space of a couple of hours. American froghoppers ocasionally become numerous enough to cause some damage to pastures. But on the whole, the Cercopidae are far more interesting than harmful. One species found in Massachusetts is the same as that common in the British Isles and is thought to have been introduced accidentally by early settlers in New England.

Although for more than 22 centuries men have been observing the spittle insects, the curious secret of their bubble-making mechanism has been discovered only in recent years. Previously the insects were supposed either to produce the bubbles from inside the body or to create them by lashing the tail about in the manner of an egg beater. This series of magnified action close-ups, obtained by a new technique employing synchronized photoflashes and a magnifying lens, reveals the successive steps in the construction of the froghopper's unique house of bubbles.

1 The story of the froghopper begins in the spring when the insect hatches from an egg laid in plant tissues the previous summer. Inserting its little beak in some tender stem or leaf, it begins pumping out the sap which provides it with both food and shelter. The insects select a wide variety of plants, sometimes even poison ivy. Half a dozen masses of froth may be found on a single plant, and occasionally more than one of the squat, immature froghoppers will be discovered inhabiting the same froth-mass





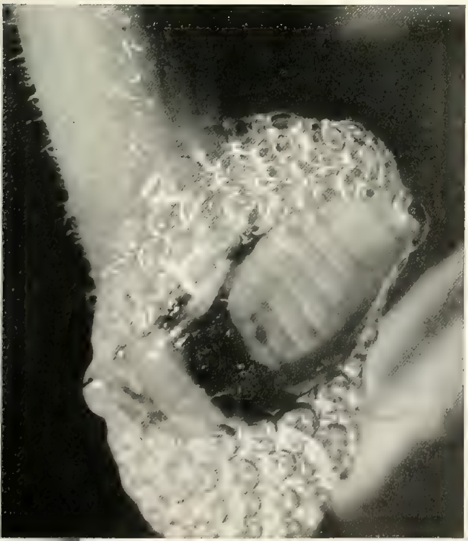


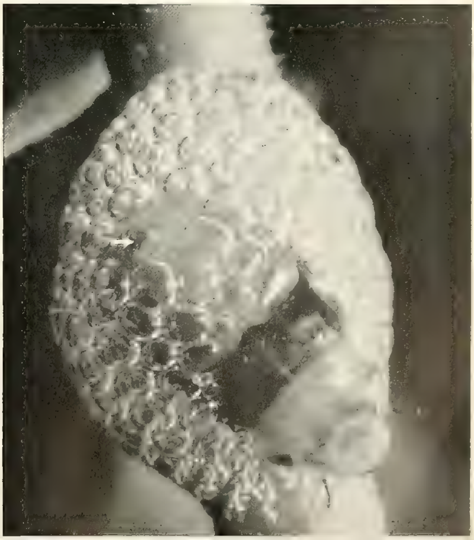
2 IN STARTING the production of its curious shelter, the froghopper always takes its position head downward on the plant. Thus gravity helps pull the mass of froth, which is produced at the tail, down over the insect. As the first bubbles are made, the hind legs also assist in pulling them downward. The initial bubbles, forming the "foundation bricks" of the future froth-mass, are seen here in the pool of sap

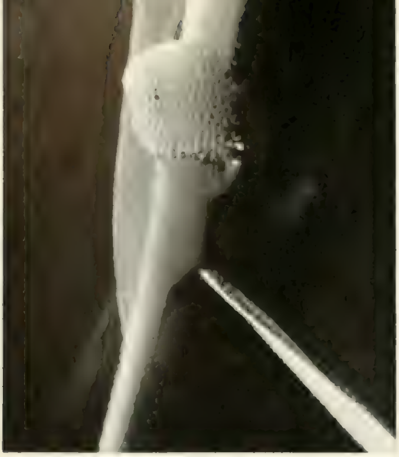
3 MOST OF THE BUBBLES in the mass are approximately the same size. This is because of the mechanism by which they are produced, a mechanism unique in the animal kingdom. Along the underside of the abdomen two rows of opposing plates, or scutes, overlap to form a channel outside the body. Each time the tail rises above the pool of sap, as shown above, the terminal plates separate slightly and air is taken into the channel. When the tail is depressed again, the air is forced out in the form of a bubble

4 HERE the insect pump is caught in action. The bubble is forming as the tail descends. Like a steadily operating machine, the froghopper raises and lowers the tip of its abdomen, producing its bubbles at the rate of about one a second. This continues until from 30 to 50 have been made. Then the insect rests for a while before beginning again

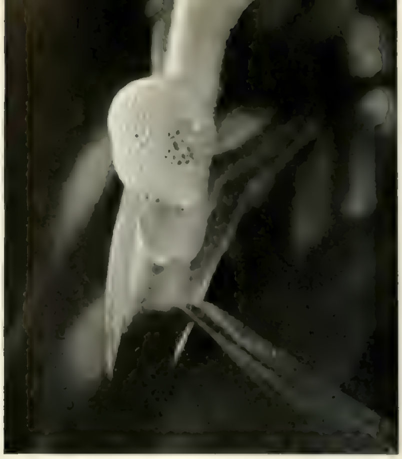
5 THIS TOP VIEW of the froghopper at work shows the triangular opening formed by the terminal plates, as indicated by the arrow. Through this opening the air enters and leaves the channel beneath the insect's abdomen. Glands within the body of the cercopid are believed to add chemicals to the sap, thus making the fluid more resistant to evaporation. Bubbles are proverbially short-lived, but those produced by the froghopper remain intact for many days





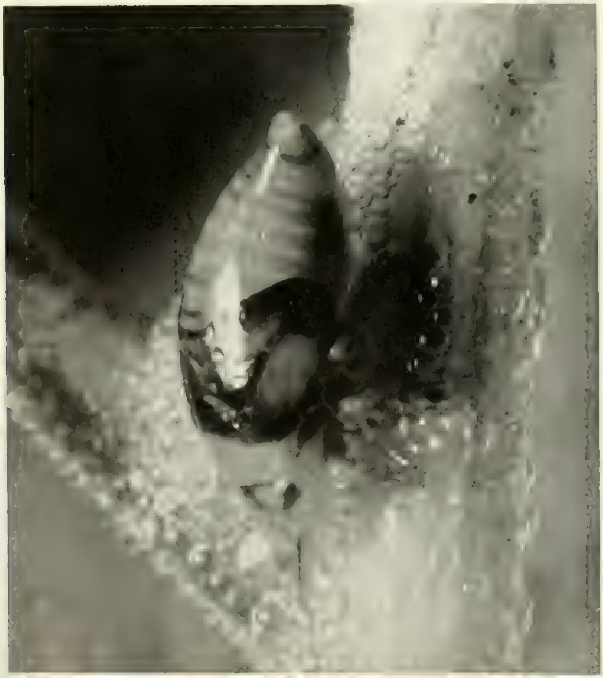


6 As the insect disappears from sight, entirely covered by the mass of froth it has created, excess fluid begins to collect at the bottom of the cluster of bubbles. In this photograph, it is seen forming a single large clear drop



7 The drop suggests glycerin, rather than water The fluid is slightly viscous and stretches farther and farther down the stem, draining away all the liquid not used in the formation of the bubbles

10 During the last stages of its stay within its bubble-house, the immature cercopid begins to develop wings. The growing wing pads, darker in color, can be seen in this picture of a froghopper temporarily driven from its hiding place



8 Just before the drop separates from the bubbles, the fluid assumes this shape. Eventually it runs down the stem of the plant, leaving the mass of froth, covering the cercopid, attached to the stem

9 Small flies and other insects often become embedded in the froth, which remains sticky for days, like whipped egg white. Sometimes as many as a score of minute flies can be found attached to the outside of a single small mass of froth. Larger insects, such as the young praying mantis shown in the picture above, are capable of pulling themselves free

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11 The final molt occurs within an open space hollowed out in the drying mass of bubbles. Here, the froghopper sheds its skin for a last time as it becomes adult. The dried foam and the discarded skin of the insect, as seen below, are all that remain behind. With wings and jumping legs to aid it, the insect no longer requires the protection of its curious house of bubbles

Natural History

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BIG PICTURES FROM LITTLE THINGS

By CHARLES H. COLES

[illegible]

THE [illegible] greatly [illegible]

The way of picture-making that involves the magnification of small objects [illegible] is neither ordinary photography nor photomicrography but lies somewhere between these two realms. Ordinary photography is generally considered to leave off when the image on the film becomes greater than the object photographed. At this point we enter the field of photomacrography.

Lenses for photomacrography

In this branch of photographic work, depth of focus becomes a difficult and important problem. It is hard to get a sharp focus, for example, on different parts of an insect's head that lie at different distances from the lens. Special lenses made for this type of work are equipped with diaphragms that enable the operator to narrow the lens aperture to achieve greater depth, but a limit is quickly set by that bane of the microscopist—diffraction. Because of this effect imposed by the size of the light wave itself, the detail of the image becomes obscured as the diaphragm aperture is closed. A compromise must be reached between the depth of focus required and the amount of detail needed for the most important parts of the object. Only by careful study of the image on the ground glass focusing screen can the best aperture be determined.

Special lenses are manufactured by various optical concerns for the specific job of magnifying small objects. The term "micro" usually is part of the name of these lenses, although they are built for "macro" work. Micro-Tessars and Micro-Teleplats are two American-made lenses designed especially for close-ups. They come in focal lengths of three inches, two inches, an inch and a half, and a half inch, depending upon the magnification required. The two-inch and three-inch lenses are by far the most useful, and both make excellent lenses for use on your enlarging camera.

Ordinary camera lenses may be used for photomacrography, but as they are not designed for such work they will not produce as sharp an image as the special lenses. Lenses made for use on amateur motion picture cameras make rather good "macro" lenses. For better results when using anything but the special lenses, it is advisable to reverse the lens so that the back of it faces the object being photographed. Of course, you probably cannot adjust the diaphragm as easily with the lens in that position, but better definition will result in the picture, because the lens corrections will be superior. Ordinary camera lenses are designed to work from a large area (subject) to a small area (film). In photomacrography the subject becomes the small area and the film the large area; hence the need for reversing the lens.

The camera

The camera for photomacrography should be equipped for ground glass focusing. A miniature camera so equipped is satisfactory for such work when lens extension tubes are used. A larger camera, on the other hand, permits greater initial magnification because of the larger film it uses. A long bellows extension is a great help in increasing magnification and maintaining depth of focus. If the camera is designed to operate vertically rather than horizontally, greater convenience will be enjoyed because it will be easier to support the objects under magnification.

In ordinary photography, the shorter the focal length of the lens used, the greater is the depth of field for any given aperture number, but when working with photomacrographic equipment, a reversal of the usual rule is observed. A six-inch focal length lens will then have a greater depth of field than a two-inch lens but will require an extraordinarily great bellows extension to achieve a magnification comparable to that obtained by the shorter focus lens. A compromise must usually be reached by using the maximum bellows available and then fitting a lens which will give the required magnification.

A point to keep in mind is that still further enlargement of the subject can be achieved by enlarging the negative. This type of enlargement does not add to the detail recorded, but as the film will usually record more than can be seen with the unaided eye, enlargement from the negative brings up this fine detail to a size that the eye can appreciate.

Lighting the object

In photomacrography the lens usually has to be placed so close to the object that illumination is not easy. Baby spotlights or microscope lamps are the most convenient sources of illumination. The smaller the lights, the closer they may be placed to the camera. Lighting is simplified by mounting the camera lens at the end of a tube. In this way the body of the camera does not interfere with placing the lamps in a position to light the object from the front.

It is important to illuminate the background behind an object as well as the object itself. A dark background is desirable when photographing a light-colored object, and vice versa.

In scientific work, photomacrography is

[illegible]

YOUR NEW BOOKS

UNDER THE SEA-WIND: LIVES OF SEA-BORN CREATURES
WORLD OF BIRDS: UNIVERSAL LANGUAGE OF BIRDLORE
HEAD-HUNTER BY THE ORINOCO • MAN, A SOCIAL ANIMAL

ABOUT OURSELVES

- - - - - - by James G. Needham

Jaques Cattell, $3.00

MOST zoological treatises on man are content with placing him in the hierarchy of nature, tracing his evolution, establishing his relationships and completing the job with comments on his comparative anatomy. Professor Needham has a fresher viewpoint. He does, it is true, begin at the beginning with a clear, succinct description of man's zoological position, but after this preliminary orientation he launches into human behavior from the biological aspect, and then broadens his scope to deal with man as a social animal, emphasizing throughout the fundamental organic principles involved.

Naturally, since these are subjects of enormous extent the treatment accorded them is necessarily brief and cursory. Nevertheless, he has succeeded in presenting in completely simple and direct language a fascinating exposition of the essential nature of man. It is an account designed for popular reading and should be an admirable introduction for lay readers into a vast and complicated field.

H. L. SHAPIRO

UNDER THE SEA-WIND

- - - - - - - by Rachel L. Carson

Simon and Schuster, $3.00

WHILE Rachel Carson is gifted with a magical imaginative faculty that enables her to project herself into a world far removed from mankind in the scale of being, she also possesses remarkably accurate powers of observation and a quickened, almost instinctive perception of the motivating causes underlying the activities of that world.

In *Under the Sea-Wind,* she has put these faculties to full use. The changes of the tides, the ocean currents, the growing promise of spring warmth, and the winds blowing from the sea start mysterious migrations of sea life from birds and fishes to the tiniest invertebrates of the plankton. These streaming seasonal mass movements, associated with birth of new generations, competition for food, and changing phases of rhythmic life histories, become the theme of this vital book, as the author follows them through their successive stages.

First, she accompanies the sandpipers in their migration from a Carolina beach to the Arctic and back, in the fulfillment of their racial destiny. Second, she visualizes the mackerel, born in the open sea by the billion, destroyed by the million, struggling through many vicissitudes as they pass their phases of growth and migrate to the shallows of quiet harbors to spend their adolescent period until autumnal storms and cold drive them once more to the deeps, eventually to spawn and thus complete their cycle of life. Finally, this saga leaves the sea temporarily to penetrate the hills to an upland pond where the sluggish eels for ten years have fed and grown large and fat until suddenly, one fall, the impulse comes upon them to join with hundreds of other eels in a mass movement to the ocean to search out their original birthplace in the deeps near the Sargasso Sea.

The magic of Miss Carson's pen paints the absorbing lives of these sea-born creatures so vividly that, like the author, the reader seems to lose his human identity and becomes, for the time being, an inhabitant of the watery world.

ROY WALDO MINER.

WORLD OF BIRDS

- - - - - - - - - - by Eric Parker

Longmans, Green, $3 00

ALTHOUGH the author's world of birds does not include America, he speaks the universal language of birdlore. Bird-lovers in this country will do well to add his volume to their libraries.

We may also suggest that Mr. Parker consult, if not, indeed, acquire the standard American works on birds. In them, for example, he will find information concerning the rolling call of woodpeckers that English books apparently do not give to his satisfaction. Strangely enough Mr. Parker expresses his belief,—one that few, if any, American ornithologists share—, that this call is vocal. Who, for instance, that had seen a flicker's evident preference for a tin leader pipe as a drum, would doubt that it used its bill as a drumstick? While of the role of the hairy woodpecker, Forbush in *Birds of Massachusetts,* Volume II, page 258, writes: "On bright March days this bird begins to practice what is either a love song, a challenge, a call to its mate, or all combined. This is no vocal music but instead a loud drumming on some resonant dead tree, branch, or pole."

As more readily available, we also refer Mr. Parker to Witherby's *Handbook of British Birds* (Part IX, 41), a work that we in America accept as authoritative. Here the call of the British great spotted woodpecker is described: "A loud grinding rattle, which apparently functions as a song, is made in spring by extremely rapid and vibrating blows of bill on trunk or branch of a tree."

Mr. Parker also throws doubt on the accepted explanation of the snipe's (*Gallinago*) drumming by quoting the observations of a correspondent who writes that he has seen the bird produce this sound while "on the ground, standing perfectly still with the exception of a definite movement in the throat."

In his final chapter, "Bird Song in Poetry," Mr. Parker deals with less controversial subjects; here the poet has an advantage over the professional ornithologist. What he writes remains for all time as he wrote it. *The Birds* of Aristophanes is still *The Birds* of Aristophanes, but the birds of Aristotle are more or less a curiosity. Moreover, the birds of the poets know no faunal boundaries, and here, therefore, we may meet with Mr. Parker on common ground.

F. M. CHAPMAN

I WAS A HEAD-HUNTER

- - - - - by Lewis V. Cummings

Houghton Mifflin, $3.00

PERHAPS unequalled in recent books of nonfiction is the unique story which the author tells of his experiences in the upper Orinoco basin. Starting alone with a minimum of equipment from Bogota, Colombia, the seven-month journey across the mountains and down the upper reaches of the Guaviare River is summarized in one all-too-brief chapter. The balance of the book is the narrative of nearly a year and a half spent with a small, isolated tribe of head-hunters. His experiences include an initiation ceremony, a head-hunting raid, the daily life and routine which he shared, and even his simultaneous marriage with three of the girls. Much is new ethnological information, as the presence of a tribe accustomed to preparing shrunken human head trophies had not previously been reported in the Orinoco basin. He has written candidly and sympathetically of these people, who won his respect and affection. A few of his observations, as presented, may be open to question, but to check these one would almost have to duplicate his experience, and it is extremely doubtful if a candidate could be found, willing to attempt this.

JUNIUS BIRD.

LETTERS

Sirs:

[illegible] of NATURAL HISTORY [illegible]

[illegible]

Los Angeles, Calif. [illegible]

• • •

Sirs:

I have been reading with a great deal [illegible] NATURAL HISTORY [illegible] most exceptional mother in beardom." I don't know whether this is because she is the mother of four cubs in one litter, or [illegible] clown. If the four-cub record is the cause, I have one that will equal that.

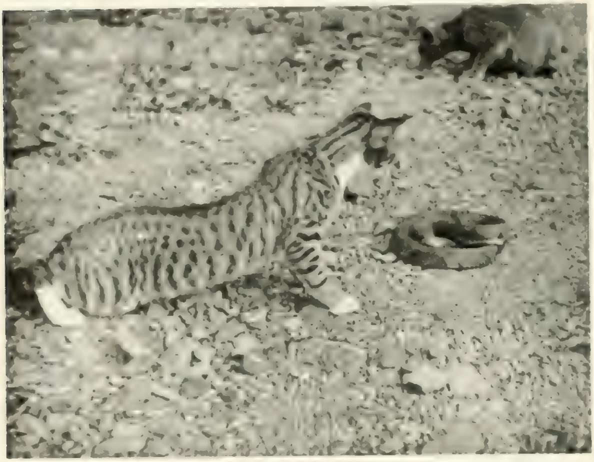
Late in May of 1926 I was hunting [illegible] Alaska Peninsula with [illegible] as guide. One morning we were crossing a broad valley with very little cover, and had the opportunity of watching for more than half an hour a mother brown bear with four cubs. None of them was larger than a cat. When she came to small, wide, but shallow streams [illegible] two of them to wade across with her, but those that didn't wade she had to take by the back of the neck and carry across.

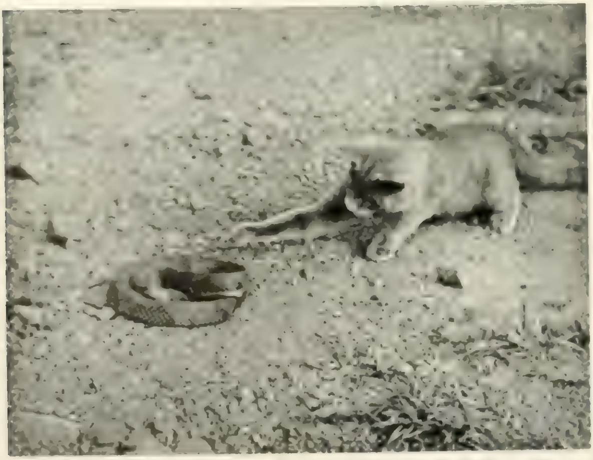
We did not get a photograph of them, because we were afraid that if she discovered us she might attack, and the last thing that we wanted to do, of course, was to shoot a female bear, especially one with four cubs. . . .

[illegible] who has been in Alaska [illegible] years and, I think, has hunted every year, told me that he had never before seen or heard of four brown bears in one litter.

EDWARD J. GARRETT

Seattle, Wash.





• • •

Sirs:

Please find enclosed ten cents including the cost of postage for this month's [November] cover of NATURAL HISTORY. . . . May I express deep appreciation for your magazine. I find it a great help in the type of work that I am doing, particularly in summer camps.

ERIC [illegible],
Boys' Work Secretary

Y. M. C. A.
Kingston, Ontario

• • •

Sirs:

We have two cats, a Maltese and a "tiger," and these photographs were taken when they were carried outdoors to have their first look at a copperhead snake. Both evinced, in different ways, marked fear of the snake. It measured 40 inches in length, and the diamonds on its back were perfectly matched throughout its entire length. The snake had been killed but a short time, and the tail was still moving slightly.

The Maltese, when set on the ground a few feet away, leaped wildly into the air, letting out a frightened howl. Several times he reached out a front paw slowly, cautiously, to dart it forward and tip the snake lightly and then leap backward three or four feet to safety.

The "tiger" cat, the better to investigate, stretched himself to a great abnormal length, not daring to venture too close. His nervousness was scarcely noticeable yet very stiffly controlled.

Time and again out of curiosity, both would travel in a wide circle, gaining ground each time around. They could either smell the peculiar odor of the reptile or could sense through other means a dangerous foe. Their whiskers and noses twitched nervously and continuously when near it.

Many times during the summer both have chased and caught harmless garter snakes, milk snakes, and such. They played endlessly with one, leaving it partly alive, returning later to continue their play. Time and again one could see them pounce over and over upon something in the grass. Invariably this meant a snake. They showed absolutely no fear of those snakes what-

Continued on page [illegible]

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INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 64

1. The strategic metal least procurable in the United States is
- (a) Tin
- (b) Aluminum
- (c) Mercury

2. The skunk's odor may turn your stomach, but the skunk himself loves it.

True........ False........

3. Only the male skunk is equipped to carry out an odor attack.

True........ False........

4. A tiglon is
- (a) A hybrid canine
- (b) A hydrid feline
- (c) A hybrid sea lion

5. When a spotted skunk meets a dog, it
- (a) Observes a time-honored truce with "man's best friend"
- (b) Walks on its hands
- (c) Fights instantly without threatening a "gas attack"

6. Copra is
- (a) Shell money
- (b) Dried coconut meat
- (c) A poisonous snake

7. The ermine, which belongs to the same family as the skunk, fortunately does not have any disagreeable odor.

True........ False........

8. Over 400 persons have died of thirst and starvation on the Devil's Highroad, which
- (a) Parallels the Burma Road.
- (b) Connects two points in Arizona.
- (c) Crosses the Tibetan Plateau.

9. A skunk's ammunition is
- (a) An oil
- (b) A gas
- (c) A volatile liquid

10. I am on the strategic list; I come from a banana-like plant; and many years under salt water fail to impair my strength. What am I?

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[illegible] fauna. At one point in his thoroughly [illegible] he observes that ". . . the African elephant [illegible] I hope that because of the time I have spent on his trail I have been able to make this majestic animal better known to the world at large, for even in our lifetimes vast changes have come and will come to their mighty herds. There are other animals, of course, that are facing extinction, but the elephant, it seems to me, is the most majestic and [illegible]

Clark admits that in earlier days he has done his share of destruction but against the handful of animals of each species that he has shot, we must weigh the consequent development of his skill at lifelike modeling and the insight that he has been able to communicate in teaching the art to others. Nothing worth-while is gained without sacrifice. The Museum groups that have been raised by Doctor Clark's hand or under his direction stand as immortal tributes to the individual animals whose death was involved in their creation as well as to the entire species represented. Industrial civilization, not the serious student of their anatomy and behavior, is the real and inexorable enemy of the animals.

Bandits

By far the most spectacular of the score of expeditions which Clark has undertaken was from Bombay to Pekin, a 3000-mile trek across the bleakest and most uncivilized part of Asia, with William Morden in 1926-1927. The Mongolian desert is so arid that the explorers grew enormous beards to save shaving water and even packed snow in burlap bags with which to allay their thirst. The quest for those rare creatures, the ibex and the Marco Polo [illegible] the Museum's Hall of Asiatic Mammals, led Clark and Morden hundreds of miles beyond civilization, where few white men ever penetrated before. Clark had known what it was to face the big mammals of Africa at their most ferocious. Here he was to come face to face with what, at its worst, is a far deadlier animal—Man.

On a trumped-up excuse the two white men were set upon by a group of Mongol guerrillas manning an isolated post near the Russian border. The explorers had entered the tent in good faith, leaving their firearms with the caravan, when — but let Doctor Clark tell the tale:

"I saw Morden [illegible] his wrists in front of him, and wondered what would happen now. Then my own were crossed, and they began to bind us.

"For a little time the Mongols had seemed to check themselves, but now, once more, their fiendishness broke loose. A man stood over me and passed a section of rope through his mouth, spitting on it as he did so. I remember thinking that he was placing some curse or other on it, but I had little time to think. My mind seemed clear enough, but my thoughts seemed to have little time for continuity. I had no conception of what such creatures might do. I was trying to outguess [illegible] trying to appear [illegible] trying to make as little trouble as possible in order that they might restrain themselves somewhat. And now they wrapped the rope about my wrists. Half a dozen times it was twisted about them, and a knot was tied.

" . . . the two who had held me let go my arms. Now they each seized an end of the rope that bound me, and placing their feet against my wrists, they pulled with all their might. They chattered madly and they jerked. Now and then the foot of one or the other slipped from my wrist, and they chattered more wildly yet. I could feel the bones grate together, and I closed my eyes again, expecting every instant to feel my wrists break.

" . . . I saw a big Mongol stoop over the fire and take from it a kettle. It held water, I believe. Possibly it was tea, but whatever it was, it was hot. I saw him stoop over Morden's face, and Bill, who had not made a sound up till now, recoiled.

" 'God, they're going to scald me!' he cried, and I saw some of the water slop over the edge of the pan and fall directly toward his upturned face. I was fascinated with fear. He was to be [illegible] and I next. [illegible] seemed certain to me. But Bill jerked his face away, and the water fell harmlessly to the ground. Then it was that I saw what they planned to do. The ropes had been pulled as tightly as it was possible for the Mongols to pull them. But they were not content with that. They poured that hot water over them in order that as our bonds absorbed the moisture they would shrink more tightly still. First they poured the water over Bill's hands and then over mine. I fully expected the hot water to burn, but it didn't. Already the pain in our wrists was fearful, and the added pain of the water—if there was any—made no impression . . . as the ropes shrank and the circulation was cut off more and more, our hands seemed to burn like balls of fire, and the pains in our arms grew and grew . . .

"We hoped against hope that they would decide to shoot us. It would be so much quicker that way. But we did not expect any such consideration. It wasn't that we were afraid of death. None of us were, apparently. We had a natural aversion to torture, certainly, but death itself was not uppermost in our minds. We would have welcomed a quick death as a means of getting away from our torturers. But more than anything else Bill and I thought of our wives. It would soon be over for us, whichever way things went, but it would be months—possibly years before they could learn what had happened, and it was possible that they might never learn anything save that we had not returned . . .

"But now we believed that we were bound for the firing line [and] we said goodby. We might not have another chance. [But we were trussed up in another tent where] our guard amused himself by aiming his gun first at one of us and then at another, crooking his finger suggestively about his trigger as he did so. He seemed to gloat over us, and often held his aim for half a minute at a time."

Fortunate indeed to escape with his life, it is a sheer miracle that Clark did not lose the use of his sculptor's hands, cruelly bound as they were for 36 hours in that frigid temperature. But today they bear no mark of this ordeal to which he was subjected by the emotional stupidities of these Mongols. Released, at last, when the irresponsible guerrillas came to their senses, Clark and Morden proceeded on to the safety of their homes in America.

Doctor Clark takes such jeopardous episodes philosophically enough, dismissing them as occupational liabilities. If one joins the army, he must be prepared to risk his life. The same goes for exploring.

The attitude is consistent throughout James Lippitt Clark's entire career. For he has vindicated as have few other men the wisdom of the adage that nothing ventured will result in nothing gained. His mechanical bent together with the flair for art were evident even in early childhood, but it was the courage to take chances, coupled with a canny New England shrewdness that brought him to the top of his profession. He was peculiarly fitted by virtue of his gifts and his temperament to carry out the work of Carl Akeley after that great man's death. The precision and beauty which characterized the execution of the African and all the other new halls in the Museum eloquently assert his claim to lasting fame.

LETTERS

Continued from page 60

soever. Not so with the copperhead,—which left us marveling at their discrimination.

MRS. JOHN SCHLENKER.

Northford, Conn.

* * *

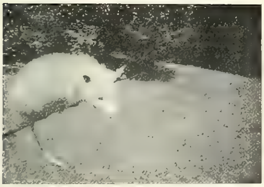
SIRS:

I have been getting NATURAL HISTORY Magazine since last Christmas and am enjoying it more than any other magazine I read. Maybe you would be interested in the photograph I am enclosing of an opossum . . .

I would be very glad to see this picture appear in NATURAL HISTORY. It is one of the first I ever made with the Baby Brownie which I got for my eleventh birthday in June.

CHRISTOPHER A. FRIED.

Newark, N. J.



SIRS:

. . . This magazine has proved very interesting and reaches a great many people. Its final days are spent in our public school library where numbers of students read it from cover to cover.

It has improved greatly from the time I received the first copy, and I know its progress will continue.

Congratulations for offering the public such a fine magazine at such a reasonable cost.

JAMES HASLAM.

Palmerton, Pa.

* * *

SIRS:

Enclosed please find a money order to cover two Associate Memberships.

This is one of the things I am always happy to pay, believe it or not, for I have spent many happy hours among your great collections and used any amount of the material in my teaching. Most of my students who have had the good luck to get there have come away thrilled and inspired to go out into far places, to see things first hand for themselves and maybe one day to add their bit to the knowledge of the world.

. . . [She] is just a senior in high school but enjoys the Magazine more than any other that comes to their home. In fact all four youngsters, ranging in age from thirteen to seventeen, fairly fight to get an evening with its pages. So I thank you for the privileges of the Museum and hope you may have a greatly increased membership to carry along during this educational depression. . . .

(MISS) C. W. B. CHASE,
Associate Prof. of Botany.

Wayne University,
Detroit, Mich.

* * *

SIRS:

We will appreciate brief mention in a future issue that Mr. Baker in using the title, "Deputy Game Warden, State of Arizona," did not reflect in any way the policies of this Department.

K. C. KARTCHNER,
State Game Warden.

Arizona Game and Fish Commission,
Phoenix, Ariz.

Needless to say, when NATURAL HISTORY Magazine published "Why Pick on the Predators," it was not the expectation of the scientific examiners who judged the article in manuscript that it would necessarily reflect the policies of any particular state. The problem involves questions on which honest men may honestly differ, and at the same time it merits the thought of every citizen interested in the country's wildlife.—ED.

DINOSAUR CHART

Through a last minute slip, the dinosaur chart in the December issue was printed with the following two labels transposed:

WITH BIRD-LIKE HIPBONES—Ornithischia

WITH "LIZARD-LIKE" HIPBONES—Saurischia

It is suggested that the readers cut out these labels and paste them over the ones on the chart in their proper positions. In the interests of scientific accuracy, NATURAL HISTORY Magazine will send without charge a fresh copy of the chart with the correction made to any subscriber sending his name and address.

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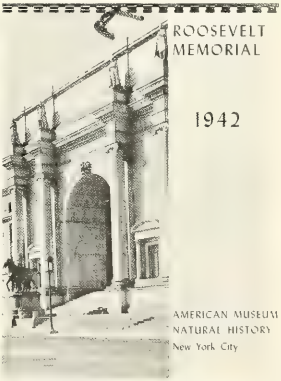

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[illegible]

[illegible] and value of these vignettes of waspish [illegible]

[illegible] able to realize the thrill that comes with [illegible] graphed under magnification takes on a [illegible]

ON YOUR RADIO

[illegible]

SUNDAYS over the Mutual Broadcasting System from [illegible] A. M.

[illegible]

•

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[illegible] the fabric and fiber of New World [illegible]

•

FRIDAYS over the Columbia Broadcasting System Network from [illegible] P. M.

[illegible]

Answers to Questions on page 61

[illegible]

DO NOT MISS

THE SMARTNESS OF THE SMART COYOTE. "Next to God," the Mexican country people say, "the coyote is the most astute animal on earth." And for sheer "foxiness," others aver, he is several laps ahead of the fox himself. Drawing on facts and folklore, J. Frank Dobie supports these contentions with a wealth of sometimes breath-taking and always highly entertaining information, woven into an article that commands new respect for a much maligned creature.

•

Roots, like faith, can move mountains. They can also climb them or bind them together. They secure food for the parent plant and supply your table with some of its most succulent vegetables. Their most important part is the tip, but where this "nose" will lead—whether into the air, along the ground, or delving deep in the earth—is a matter of adaptation. In **GETTING DOWN TO THE ROOTS,** Henricks Hodge has written perhaps his most arresting article for NATURAL HISTORY Magazine.

•

Bird-fancier and avid shore-stroller alike will take delight in William Graf's splendid photographs of **CALIFORNIA MURRES,** depicting their life and antics on one of the precarious cliffs where they make their home.

•

Our war-torn world is "map conscious" now as never before, yet few of us realize how recent a thing the accurate modern map is. In **THE STORY OF OUR MAP,** Irene Cypher will review the part that maps played in the epic of America, from Columbus' time to the present.

•

After the dinosaurs, what? In forthcoming issues, paleontologists GEORGE GAYLORD SIMPSON and EDWIN H. COLBERT will round out NATURAL HISTORY Magazine's panoramic series of articles on the history of animal life in North America. The next installment will tell how, after an age in which monsters of great size and strength achieved world domination, the meek inherited the earth.

February **NATURAL HISTORY** 1942

Strategic Tungsten · Map Makers · Fresh-water Giants

Rise of the Mammals · Smart Coyote · Amazing Roots

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of
1942

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LETTERS

SIRS:

I have just finished reading for the second time, "Don't Skin Your Skunk," by M. R. and C. M. Bogert. This is the most interesting and informative article I ever read on skunks. It is well written and also supplies information about these little animals that I did not know although I had already studied them somewhat.

Perhaps Mr. Bogert would be interested to know that I have seen the little spotted skunk do the handstand for me instead of a dog, not only in the woods but in captivity. I once had a pet spotted skunk, and friends thought I had it trained to do the handstand, because all I had to do was to tap the wire on his cage and he would stand up on his front feet, much to the amazement and pleasure of friends and visitors. He never failed to do it, dozens of times each day.

We all admired the beautiful picture on the cover of the January NATURAL HISTORY.

ROSS ALLEN.

Ocala, Fla.

* * *

SIRS:

Your recent articles of evolution were of the utmost interest to me. I hope you continue to publish many more similar ones.

WITMER S. HUNT.

Forest Park, Ill.

* * *

SIRS:

. . . We surely look forward eagerly to your magazine in our Biology Department and class it above all others of its kind which we take here. Best wishes—always!

H. THEODORE STUBBS.

Weehawken, N. J.

* * *

SIRS:

. . . I enjoy your articles on paleontology very much. Lets have more of them.

LELAND SMITH, JR.

San Antonio, Tex.

* * *

SIRS:

I want to let you know how much we are enjoying NATURAL HISTORY, and how our children look forward to it each month. My parents, brothers and sisters, and their children have long been great admirers of your magazine, and especially of its new attractiveness and interest during the past few years. All the articles are fascinating and instructive. Among the many articles which I have enjoyed are the two by Doctor Gudger on "dogs which fish" and on "the smallest fish." I hope he will write others from his great store of knowledge in his field.

With gratitude for the privilege of sharing in the educational advantages of the Museum. . . .

CHARLES A. PERERA, M.D.

Scarsdale, N. Y.

* * *

SIRS:

Although I have not been a subscriber very long I enjoy every copy and look forward to the next.

I especially like the articles on extinct animals. Your "Dinosaur Family Tree" was good. . . .

NICK HARMON.

Harriman, Tenn.

* * *

SIRS:

I had seriously thought of giving up NATURAL HISTORY this year . . . but I shall miss it dreadfully if I do, so here goes for one more year at least, and no doubt many more.

It seems to me once you have taken NATURAL HISTORY you can't give it up even though you think you can.

MRS. MABEL A. THORNTON.

Vineland, N. J.

* * *

SIRS:

. . . Your magazine is marvelous—it is instructive, entertaining, and beautiful, and I look forward eagerly to its coming every month. I am proud to be a member of your wonderful organization.

(MRS. GEORGE W., JR.) GRACE F. H. HEAD.

Dover, N. H.

* * *

SIRS:

I have just finished reading my second issue of NATURAL HISTORY. Of all the magazines to which I subscribe, it is the most fascinatingly appealing. In my work as a teacher of biology, I find it immensely valuable, and in my hobby of photography it furnishes an inspiration and a goal toward which to strive.

R. D. MIERSWA.

Sheboygan Falls, Wis.

* * *

SIRS:

It pleases me to say that we have never had a more beautiful or more informative magazine in our home than NATURAL HISTORY, and I want to thank you for the great pleasure it gives us.

(MRS. ERNEST) MARY ROBINSON.

Kansas City, Mo.

Continued on page 67

NOTICE

Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

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[illegible]

CARRION PLANT

By [illegible]

"T[illegible]

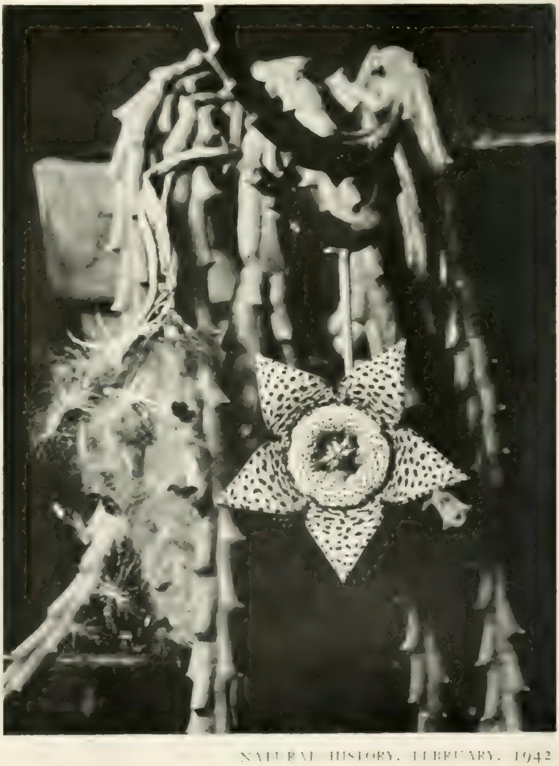
[illegible]

[illegible] green flies and other carrion loving insects.

[illegible] tion which resembles the bud before opening.

[illegible] ceptible change. The "bud" begins to grow, lengthening and thickening until [illegible] Within a month the growth is completed, and then [illegible] yellow and splits down the center. Thereupon flat, brown seeds, which have silken [illegible] away by the wind.

Although somewhat similar in habit of growth and general appearance, the car[illegible] related to the Rafflesia, native of the East Indies, which produces the largest flowers in the world [illegible] from ten to [illegible]teen pounds each and attain a width of three feet, with the cup inside the petals capable of easily holding two gallons of liquid.



Continued from page [illegible]

SIRS:

The accompanying photographs are two views of an unusual curiosity which I found while walking near the edge of the Helderberg escarpment near Altamont, N. Y. The first picture shows one fully formed ring of snow, and the second picture, taken only a short distance away, shows two others, one of which appears to have partially melted in the sun.

I have not yet been able to find anyone who can explain their formation. Apparently, the rings are formed in a manner similar to that in which natural snowballs are formed—by wet snow rolling down an embankment—and from the photographs it can be seen that all of the rings are at the bottom of a fairly steep slope. Doctor Zahl has suggested that possibly the rings occurred when a snowball of the type described above formed about a stone, the warm spring sun later melting the snow to such an extent that the stone sank through the snow to the ground below. My own theory is that the snow became crusty through alternate freezing and thawing, that the crust sprang outward at the top of the slope, and that the next warm spell softened it to such an extent that it commenced to roll down the hill in the manner of a hoop. The path which the ring followed and the lines of its formation can clearly be seen in the first photograph.

DUANE FEATHERSTONHAUGH.
Schenectady, N. Y.

NATURAL HISTORY regrets that in spite of diligent inquiry no further explanation of this curious phenomenon has been found.—ED.

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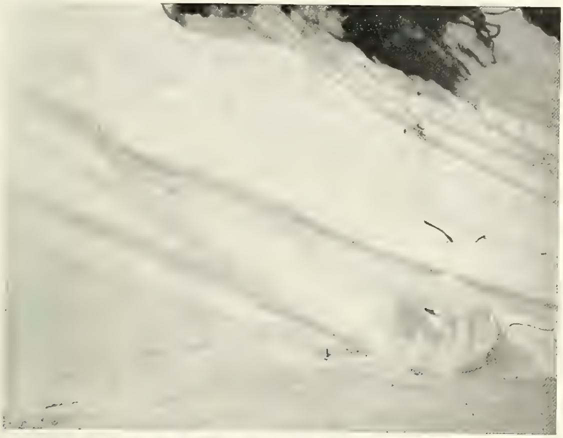

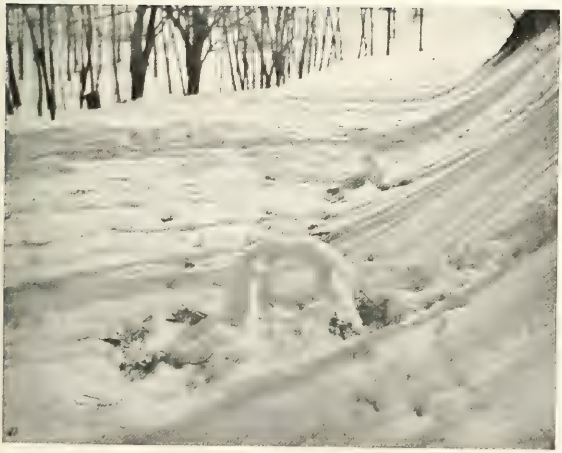

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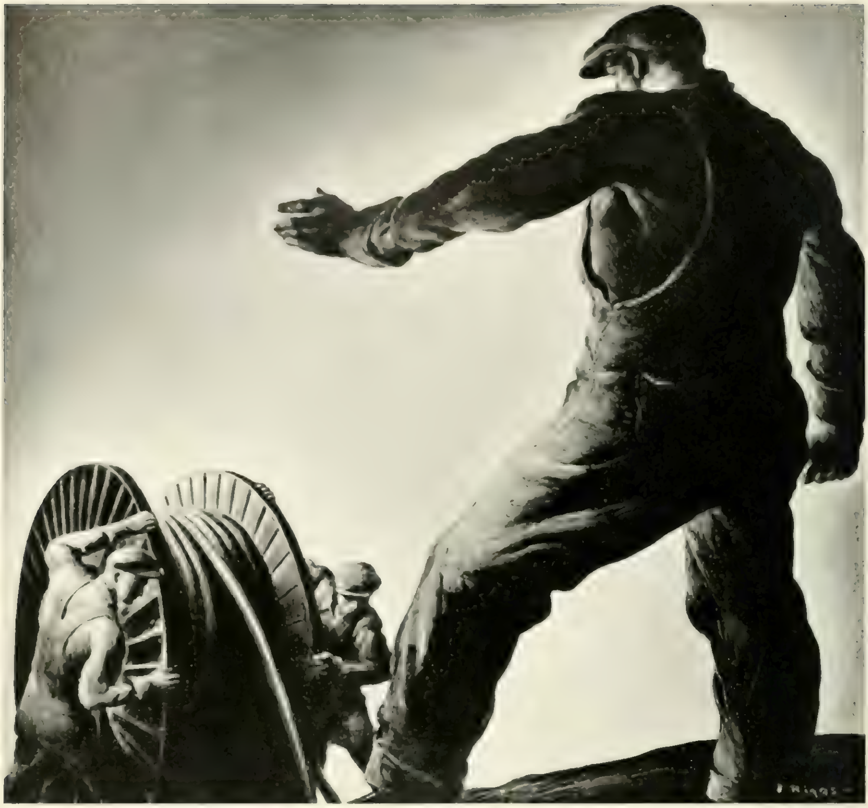
WEDNESDAY over the Columbia Broadcasting System Network from 9:15 to 9:45 A. M. (Central Time: 2:30 to 2:55 P. M.; Mountain Time: 9:30 to 10:00 A. M.; Pacific Time: 1:30 to 2:00 P. M.)

Lands of New World Neighbors. (New Horizons: C.B.S. School of the Air.) The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

•

FRIDAYS over the Columbia Broadcasting System Network from 3:45 to 3:55 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.



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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — WAYNE MOODY FAUNCE, Acting Director

VOLUME XLIX—No. 2 ★ ★ ★ ★ ★ ★ **FEBRUARY, 1942**

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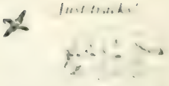
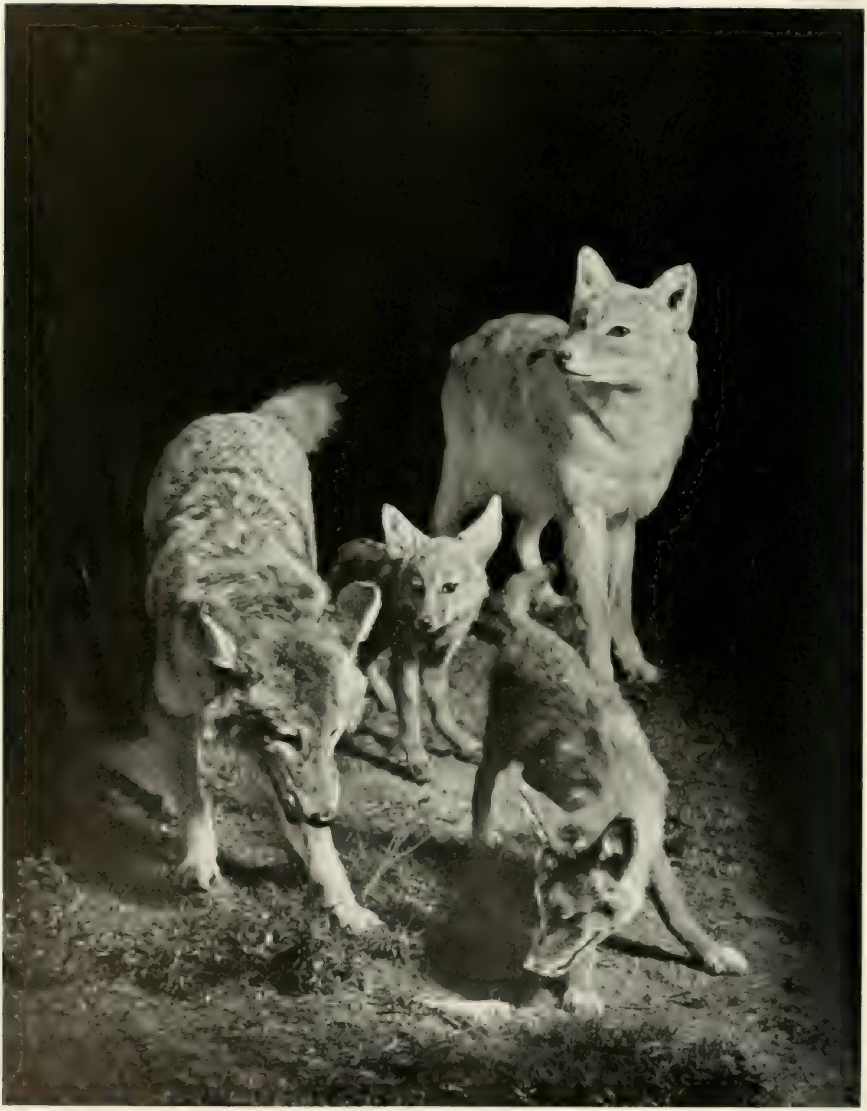
(Below) A coyote in the American Museum. At a distance the coyote may be mistaken for a tawny shepherd dog. Normally it is much less to be feared than the average stray dog


Just tracks!



Tantalizing

All in a heap

That raven!

THE SMART COYOTE

Tricks almost unbelievably clever win a unique reputation for the animal whose voice is symbolic of our wild open West

By J. Frank Dobie

"Next to God," the Mexican country people say, "the coyote is the most astute animal on earth." Rangemen will sometimes admit that he is as smart as a cutting horse,—and a cutting horse can "do everything but talk Mexican." He's at times even smarter than a steel trap, some trappers have conceded. He is so smart that centuries and centuries before the history of the native peoples of North America began to be recorded he had burned himself upon their imaginations and come to be both hero and clown of more tales than all the other animals of the continent combined have inspired.

The trouble—from the standpoint of the scientific mind—is that evidence of the coyote's smartness so often edges off into pure folklore. I have been a long time taking down evidence from many witnesses and sifting it. I am going to start out with cold facts; if I run into the yarns, I'll make a sign and swear that I don't know whether I am telling the truth or not.

Like the rattlesnake and the droll little burrowing owl, the coyote will be associated with prairie dogs as long as a prairie dog is left in coyote country. The coyote is very fond of prairie dog meat, and the prairie dogs, always on guard—except when they are safe in their underground forts—and always alarming each other at the faintest suggestion of danger, are probably the most difficult of all small animals for beasts of prey to catch. But—

> There are nine and sixty ways of constructing
> tribal ways
> And every single one of them is right.

Really smart people are various in their ingenuity.

One of the best observers and the most richly-informed homemade naturalist I have ever known was Don Alberto Guajardo, whose many years of ranching, soldiering, surveying, mining, hunting and gathering of medicinal plants for exportation had taken him over most of northern Mexico. He compiled history from ancient documents, read Latin and spoke two other languages besides his native Spanish, but he always asserted that the best contributor to his education had been an old Lipan Indian.

One time during his boyhood, he told me, he went out hunting with this Lipan. This was back in the days when Apaches and Comanches still raided, and, suspecting danger, the old Indian and the boy hid in brush overlooking a valley well populated by prairie dogs. The sky was dark and threatening rain. Before long the boy saw a coyote come out among the prairie dogs on the edge of the "town," close to the base of the big hill on which the two hunters were hidden. The coyote was not aware of them. He went to scratching, scratching at a doghole into which his approach had sent the owner, followed by neighbors into their respective holes.

"Surely," said Don Alberto to the old Lipan Indian, "that coyote does not think he can dig down to the bottom of a prairie dog hole."

"No, no," replied the old one. "He knows what he is doing. Wait with patience and you shall see."

By now thunder was rolling up, and the coyote was digging more energetically. This animal seems always to feel the approach of changing weather. The plan of the digger began to be apparent. He was merely pulling down the crater-like, encircling mounds of two or three prairie dog holes and using the dirt to throw up a rough V-shaped dam, the [illegible] getting [illegible] so that they would [illegible] water [illegible] into the opening [illegible] [illegible] by the V.

Presently the [illegible] [illegible]. [illegible] [illegible]. The water [illegible] [illegible]. [illegible] the coyote's dam poured into the holes. Meantime the coyote had placed himself back of the dam, at its apex, where he awaited results. The typical prairie dog hole has [illegible] a foot or [illegible] from its mouth, where the owner, with his family, can remain clear of the water at the bottom of his burrow. Sometimes the burrows are connected. Water will not reach the prairie dog and his store of food until the hole is filled from the bottom. Many a boy has [illegible] out a prairie dog by pouring buckets of water after him. But here a stream of water was being diverted into the holes. Before long the watching Indian and Mexican boy on the hillside saw a prairie dog emerge, only to be nabbed by the ingenious coyote.

Not long ago I spent a day and a night with H. C. (Pete) Gamison at his cabin overlooking Eagle Nest Lake in northern New Mexico. For nearly 50 years he has been hunting, poisoning, trapping lobo wolves and coyotes. He has enough education to give perspective to his natural intelligence and observations. Not many men alive know at first hand as much about the wolf family as he knows.

One time, he told me, he watched a pair of hungry coyotes out to catch a prairie dog. They tracked leisurely along, one right behind the other, towards the edge of a prairie dog town. Presently there was a great chattering at them. But the prairie dog they were headed for could see only the lead coyote, the one behind keeping his head down and his body hidden by that of the first. When near the mound on which the prairie dog stood nervously scolding, the lead coyote made a rush, and, of course, the prairie dog ducked. The sun was shining from a clear sky and when the coyote leaped over the hole he darkened it with his shadow. He went on, other prairie dogs chattering and ducking, the noise growing dimmer as he passed.

But the second coyote had stopped when the first one leaped, and while the play was going on, he flattened himself out as flat as he could behind the dog mound. There he waited until the prairie dog should come up. Before long he reappeared, looking with intentness towards the enemy that had threatened and passed, but was still in sight. It is the nature of a prairie dog to look for what has scared him. While this one was indulging his nature, expressing his displeasure at the same time, the accomplice of the first actor made a leap and caught him. Then there was a tussle over the morsel, the two coyotes soon tearing it to pieces and devouring it.

By coincidence, three or four days after Pete Gamison had enriched me with his coyote lore, I paid a visit to the veteran naturalist and teller of animal tales, Ernest Thompson Seton, at Seton Village, near Santa Fe. After hearing talk on wolf sagacity, I came away with a copy of Mr. Seton's recently published autobiography, *Trail of An Artist-Naturalist.* A few hours later, I read this passage:

> [illegible] behind a thick greasewood, the [illegible] walked [illegible] toward a prairie dog that was [illegible] [illegible]. He made a half-hearted rush as the little dog dipped. The coyote [illegible] back behind the greasewood [illegible] and [illegible] behind a bush that was [illegible] six feet from the prairie dog hole. Meanwhile Coyote No. 1 sauntered slowly forward. Presently the prairie dog [illegible]. He saw that Coyote No. 1 was at a safe distance and that he was going still farther away. [illegible] he stepped right out and [illegible] at Coyote No. 1. Coyote No. 2 rushed forward and almost got him. In this case the trick failed but obviously it must often be successful.

An old trail driver and cowman—J. H. Maltsberger, of Cotulla, Texas—not at all given to the fanciful tales he has often heard, told me that early one morning he saw a coyote closing up prairie dog holes in a certain part of a town. Later he got a prairie dog cut off from its own hole. Naturally it made for the next nearest hole—one that the coyote had with malice aforethought plugged. The hesitation at the closed door cost this prairie dog his life.

After bringing sheep and goats to America, the Spanish *conquistadores* soon came to recognize the coyote as the chief enemy of these small animals, though one encounters no record of its interfering with the spread of cattle and horses. The early Spanish historian Clavigero describes the coyote as using its tail as a whip. Having picked out a fat sheep and seized it by the neck, the coyote was said to lash its victim in the rump to urge it to a convenient place for eating. This cunningly fantastic way of leading a sheep to its own slaughter may be doubted by some naturalists, but many shepherd people both in Mexico and the United States aver that it is true. The coyote is not strong enough to move a carcass in the manner of the mountain lion, and so if he moves it at all, he must use his wits.

In the old days before coyotes had been killed off sheep ranges and before wolf-proof fences had been put up to keep them out, dogs were essential to every shepherd guarding his flock, especially at night. Then it was common for one or more coyotes to make a feint attack in the darkness on one side of a flock, drawing all the dogs after them; meanwhile other coyotes cut in from an unprotected direction, getting their meat in such a hurry that they would be gone before the guards reappeared.

It is the neck of a chicken, as with goats or sheep, that the coyote aims to seize. His hold on the neck is not invariable, but whereas a coon will seize a chicken by the leg or wing, making off while the chicken's squawk arouses dog or man, the coyote is likely to kill the chicken immediately by biting it through the neck or head. He is a noisy fellow, but he will not be heard barking or howling while on the hunt, and he seems to recognize the value of silence in his victim as well as in himself.

Dogs may learn better than to attack porcupines, but few which do attack achieve a strategy that will save their faces from being quilled. Nat Straw, famous hunter and trapper of New Mexico, told me that examination of the stomachs of dead coyotes had frequently revealed porcupine quills as well as flesh, though he never found quills in the coyote's head. He was puzzled until a forest ranger described seeing a coyote root a porcupine over, seize it in the breast, which is spineless, and in this fashion gain his entrance.

Of all predatory animals, wolves are undoubtedly the most co-operative. Coyotes go beyond timber wolves in co-operation, for they relay and otherwise assist each other not only in running down game but in eluding their own pursuers. A mother coyote whose not-yet-grown offspring is being run by a pack of hounds will actually, after running a while with the young one, turn back and make right through the dogs, trying to lead them off the trail. It takes a great deal of training to prevent most dogs from switching on such a trail.

For ways that are dark and tricks that are effectual, followers of hounds in the vast brush country of southwestern Texas will tell you that the coyote is several laps ahead of the fox. One summer night while I was out with a group of these brush country hunters, we heard the dogs running for hours in an area hardly two miles square. The dogs were having a wonderful time; they were giving us wonderful hope and expectation; and I believe that at least one coyote—maybe more than one—was having a wonderful time.

An hour or so before daylight a man named Wright dropped out of the race, saying that he was going to take a nap on a nice bed of mesquite grass he had spied close to a mesquite tree and that he would rejoin us when we came back his way. Upon our return after sunup he told how, at daybreak, he had heard the dogs making eager music fully a half mile off, seemingly coming his way, when two coyotes trotted into sight. One of them looked mighty hot and tuckered out; the other appeared to be entirely fresh. They did not sense him, apparently, and presently the tired coyote disappeared in a direction leading away from the hounds while the fresh one tore out in their direction. It is certain that the dogs did not run down a thing on that hunt.

Coyote teamwork after jack rabbits, antelopes and an occasional deer has been observed many times. It is the nature of these animals to circle when pursued. Coyotes will take stands—pretty much as mustang-hunters used to in running down the great-circling mustangs. As a fagged pursuer comes up behind the game, he is relieved and drops out for a rest until it is his turn to run again.

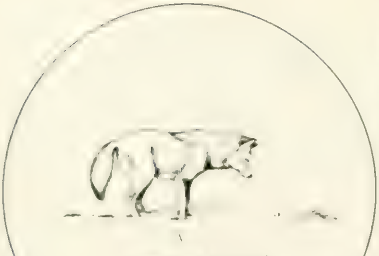
Riding one day over a divide in Montana with another rangeman, Malcolm S. Mackay, in *Cow Range and Hunting Trail,* tells how he noticed a coyote sitting on a hillside and intently watching something in the valley below. Looking in the same direction, the men soon saw another coyote coming behind a jack rabbit. After a circle that covered perhaps a mile, the rabbit passed near the waiting coyote, which now dashed in while the first coyote dropped out.

> Going downhill, the coyote would almost catch Mr. Jack Rabbit. He would have caught him if Mr. Jack had not done some real dodging. Going uphill, the long springy legs of Mr. Jack gave him a distinct advantage, but in that country there are as many valleys as there are hills, and so what the jack gained going up the coyotes gained going down. The race went on for three complete laps. Then, after having saved his bacon numerous times by flattened-out dodges, the jack quit circling and ran straight up a ridge toward a mountain. The last we saw of him he was doing well, with both coyotes far behind.

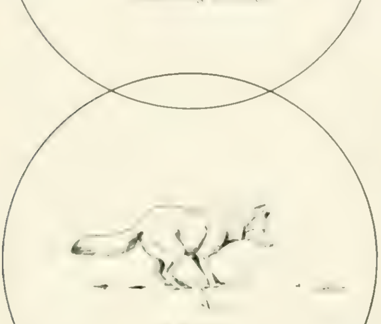
An old rangeman and hunter named George Bigford told me that he had seen as many as eight or ten coyotes round up a number of jack rabbits and keep circling them while one coyote would run in and catch himself a mouthful. At this the rabbits all scattered, coming out so thick, however, that nearly every coyote in the roundup caught one.

One winter while I was deer-hunting in the brush country, I tied my horse on a hill and began slowly walking along a dim trail that wound down a brushy draw. Before long I saw in a sparse opening ahead of me a coyote haunched down on the left-hand side of the trail. He was looking very intently, though in a manner altogether patient, to the right. I stopped to watch him. I did not wish to shoot him. For maybe two minutes he remained absolutely motionless; then he sensed me and disappeared.

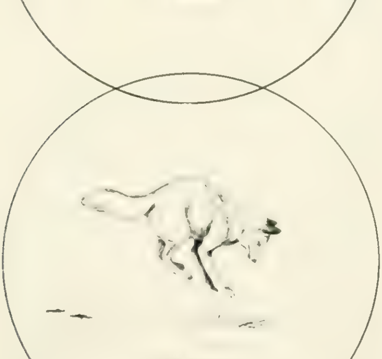
When I stepped to the spot he had occupied and looked where he had been looking, I saw a badger digging into an enormous rat's nest of cactus leaves



Something stirring!



A mouse?



The pounce

[illegible] tracks both up and around a clump of prickly pear. The badger is strong in his senses. This one was not in the least disturbed by my nearness. Directly he got down to the rat living in the nest and, as the wood rat scuttled out, coming my way. Had I been a coyote, or had the displaced coyote been in his elected position, that rat would certainly have become a juicy morsel. A Mexican goat herder told me he had seen as many as three coyotes hanging around a badger, waiting for him to scare out wood rats. Of course, the badger sometimes catches a rat himself. A well established nest usually has more than one runway into it. A coyote can dig very well indeed in soft ground himself. He knows where he can dig in a sandy arroyo down to water, and he knows when to let the badger dig for him.

Perhaps there is a kind of understanding between the coyote and the badger. The Mexican name (Indian in origin) for badger is *talcoyote*—"like a coyote." Suggestive of the relation between the two animals, a pot that I have, 2000 years old perhaps, excavated from ruins in Mexico, shows a coyote head on one side and a badger head on the other. A badger has been observed following—as best he could, for he is not a swift runner—a coyote that chased a cottontail into a hole. The presumption is that the badger expected to dig the rabbit out, not for the coyote's benefit, however. The coyote sometimes gets a gopher excavated by a badger, just as he does a rat. If a female coyote can find no better place, she will den and pup in a badger hole.

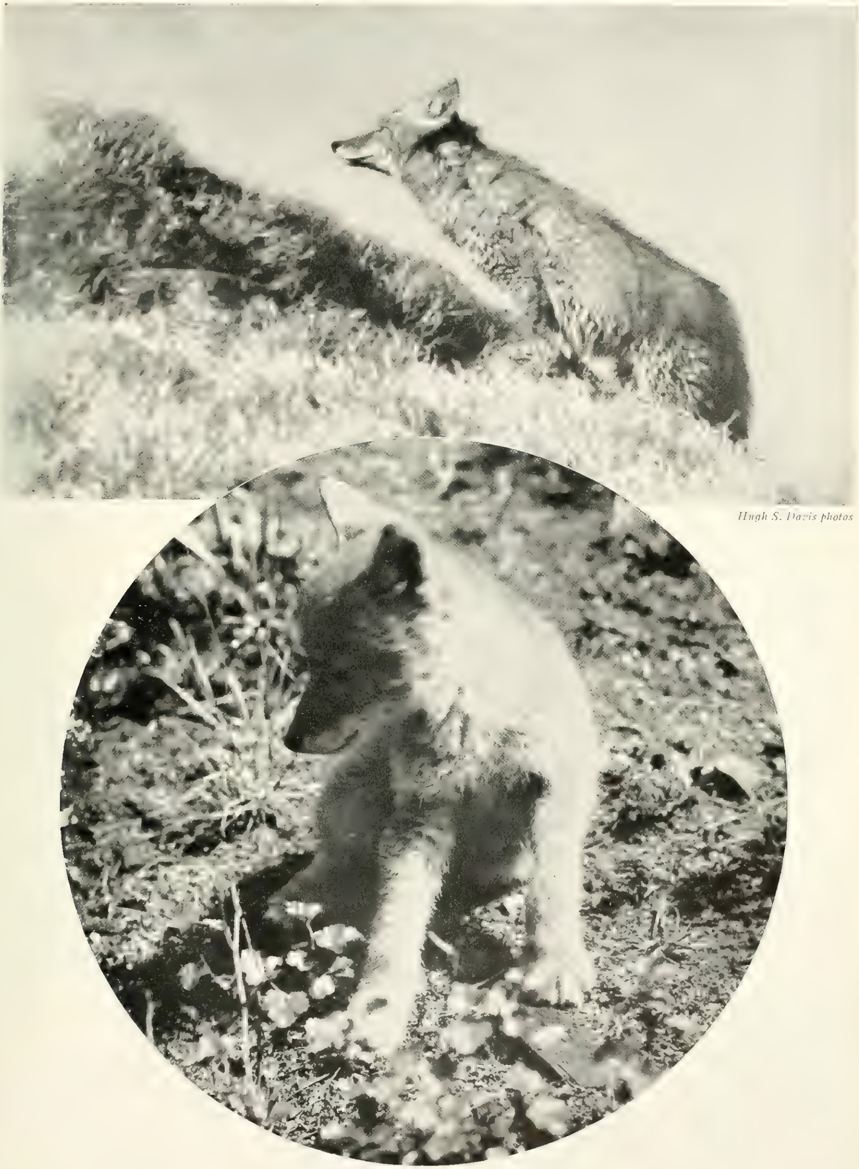
Mary Austin, who made many acute observations on the wildlife of the Southwest, says that the coyote watches crows and buzzards—"tracks in the sky," as the Indians call these birds—for guidance to carrion. The coyote that will touch a carcass left by a mountain lion, no matter how many signs point to it, is the exception, however. He is afraid of the mountain lion, which occasionally eats coyote flesh.

Over and over, in ways endlessly various, the coyote has proved himself extraordinarily adept at taking advantage of the situation. If he can't get meat one way, he'll get it another. If he can't get meat at all, he'll thrive on berries, acorns, watermelons, any vegetable food that any other animal eats. He can fish like a coon. He is as omnivorous as human beings or hogs. No other creature of the wild has so well adapted itself to the changes wrought by encroaching civilization. Chased off of sheep-grazed and chicken-pecked plains, he is now found in high mountains, away up on the Yukon River, far east of the Mississippi River—places that a generation ago were unknown to the species.

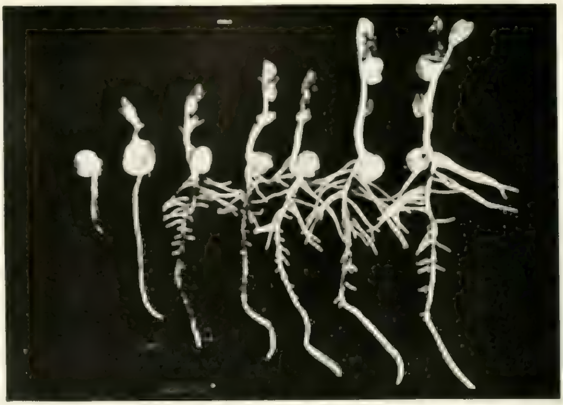
Truly, he lives by his wits. May his shadow never grow less!

The coyote has remarkable ability to adapt himself to a new situation. He therefore finds it less necessary to retreat before man's advance

(Bottom circle) **A young coyote.** Five to seven are generally born in one litter. The den is usually a hole in a bank or among rocks



Hugh S. Davis photos



SPROUTING pea seedlings make their critical all-out dive for moisture and dissolved minerals. Unless they get both, death is certain

Ge

R

ng down to the
OOTS

Roots, like faith, can move mountains. They can also climb them or bind them together. Though a single root system can penetrate miles of soil, its most important part is the first quarter-inch. But where this "nose" will lead—whether into the air, along the ground, or delving deep in the earth—depends on the often astonishing individuality of the plant

By HENRICKS HODGE

ALL PHOTOGRAPHS BY THE AUTHOR, UNLESS OTHERWISE CREDITED

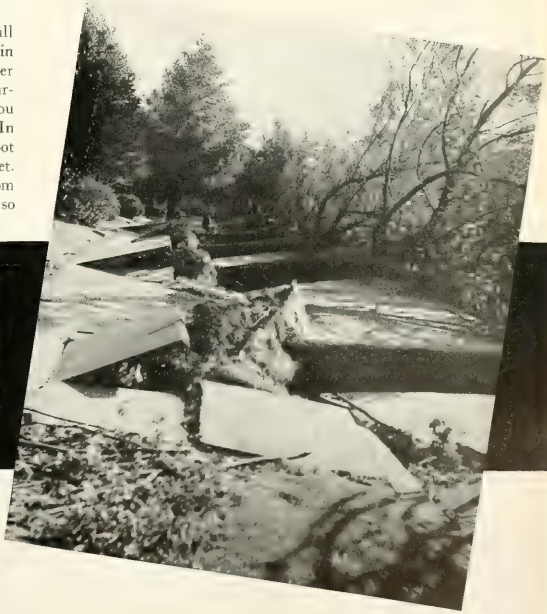
MOST roots are reticent things. Even the first young root of the sprouting seed pushes out furtively and dives to spend a mole's life beneath the ground. The result of this habit is that we know considerable about all other plant organs—leaves, stems, and flowers—, but our knowledge of roots is comparatively small.

To be sure, anyone who has ever tried to dig up even a small tree knows what a tough job it can be and how strongly the roots attempt to fulfill one of their principal functions—to support the tree. And again, when one's Oriental poppies die after transplanting, the importance of roots in a plant's life is only too strongly brought to mind.

Primitive peoples probably knew more about the kinds of roots than do their civilized descendants. This is to be expected, for in early times the ability to recognize this or that kind of root went a long way towards solving problems of meals and medicine. Certain early Greek physicians derived their title from these subterranean plant organs: they were the "root-cutters," the rhizotomi. These folk believed that all the healing properties of plants were limited to the roots. Today we see the hang-over of such early beliefs in the common names of many familiar plants, such as: bloodroot, cancerroot, and snakeroot.

Roots still influence the life of man to no small degree and form important portions of his diet in most parts of the world. Just go down to the corner market and look at the familiar beets, carrots, turnips, radishes, parsnips, and sweet potatoes, and you will realize what a meal would be without roots. In the tropics yams, cassava, and countless other root vegetables play a still greater part in the daily diet. All these cultivated roots have been developed from wild ancestors and in some cases have become so changed that their origin would hardly be suspected. The wild carrot, for instance, commonly known as Queen Anne's lace, is the direct ancestor of our cultivated garden carrot, yet its root in the wild form is generally small and stringy. Some roots find their way into the arts and crafts, yielding valuable dyes and materials for basketry.

Modern plants show many different types of roots, but their distant ancestors did not. A period existed, far in the past, when no plants had roots. Indeed, there was no need for them when all life was aquatic. Those were the days when the stuffs from which plants manufactured food could filter from the water into any portion of a submerged plant's body. And those were also the days when the lowliest of plants—the algae—were the rulers of the world. Even today if you want to see plants totally undifferentiated into organs of any kind, examine the simpler algae. Some of them, like the rockweeds and giant kelps of our coastal waters, have "holdfasts" which certainly mimic roots, but the similarity is superficial and ends right there. In construction and purpose these nonassimilating, fastening organs are



U. S. Forest Service photo by B. W. Muir

UP AND DOWN. *(Left)* These knobby growths are "knees" of cypress trees, through which the submerged roots breathe. *(Right)* Anchors as well as feeders, roots delve deep, losing their strong grip only under such force as the hurricane blast which felled these trees

[illegible]

[illegible]

the planted seed, down goes the root, answering the [illegible] know what it's after. It is seeking, above all, moisture, and the mineral salts dissolved in moisture. Unless it gets both of them fast, it will fail to make a success [illegible] when the success of an infant root marks the line between the life and death of the plant.

The most important part of any root is its tip. This is the portion we seldom see, for when a plant is yanked out of the ground most of the finer roots with the tiny tender tips are broken off. It is in the [illegible] all its powers are located, for if one slices off this segment the root is helpless. The tip is the center of growth—of elongation. Here are located the root's "nose" and "sense of touch," which enable it to turn towards the greatest moisture, the best food, the most favorable temperature, or on the other hand, to avoid toxic substances and to creep around physical impediments. Such a control center ought certainly to be well protected, and it is. Creeping onward in subterranean growth, root-tips are forever running against the abrasive action of soil particles. They would soon be worn completely away were it not for the thimble-like cap or calyptra protecting them. New layers are continually added from within to replace all outside wear and tear. The root-caps of most plants are tiny—hardly visible to the naked eye—, but on aerial roots of certain large tropical species you will be surprised to find them prominent and easy to examine.

Back from the root-tip one meets the older portion of the root, just as in the aerial skeleton of a plant the trunk is older than the twigs. Like the trunk and branches, roots of shrubs and trees grow thicker with age and lay down a corky bark. Roots don't have to be big to be strong, and when they meet soil obstructions they frequently perform miracles, splitting boulders and causing sidewalks and pavings to careen. There is a case on record where the root of a birch tree entered a rocky crevice and in the interval lifted a boulder weighing 20 tons. This feat flattened out the root into a ribbon, but it at least made some room for itself.

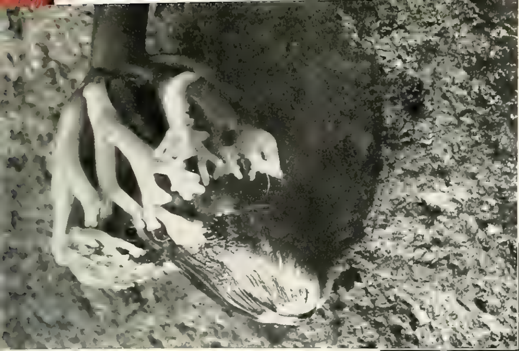
As far as water is concerned plants are the heaviest drinkers this world has ever known! Most of this liquid passes off through the leaves into the atmosphere but all of it has to be absorbed by the roots. It has been shown that in hot summer weather a [illegible] to [illegible] gallons of water a day, and most plants give [illegible] own weight. You can see what a task roots have, to supply such tremendous quantities of water, and all of it comes from the soil. No wonder lawns and gardens become dried out when rain fails to come.

Roots are efficient. In order to get plenty of water-absorbing surface many of the cells close to the growing root-tip push out to form root-hairs. These act as a pumping system, sucking up all available moisture and relaying it to stems and leaves. Unfortunately the task of the root is not as easy as it sounds; for if moisture in the ground is not abundant, the root-hairs have to fight with the soil particles for what is available. But when water is finally absorbed it goes into the root proper and thence upward to the leaves via the plant's woody cylinder.

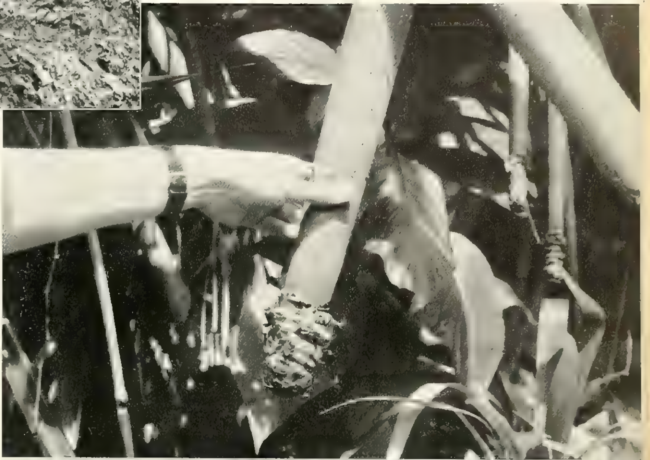
Root systems are long,—longer than most people realize, for this underground ramification is always larger than the part of the plant growing above ground. If it doesn't look so when a garden weed is pulled up, it is only because all the finer rootlets have been broken off. The root system of a single oat plant, though occupying but a cubic yard of soil, was found to measure well over 450 feet in length. At that rate the roots of a giant sequoia would have to be measured in miles!

Normal roots, the familiar underground type, take two forms. The many fine roots of grasses are known as fibrous roots. But many plants put all their faith in a single large organ or taproot, like that of a parsnip, which has but few laterals. Most taproots, particularly those of the common root vegetables, not only take in water and raw materials but have also expanded their facilities so that they may serve as storehouses for food. Certain of these plants can boast of roots that reach an enormous size, such as those of the "man-of-the-earth" *(Ipomoea leptophylla)* of the Western Plains. This bushy relative of the sweet potato, with an erect stem only two to four feet tall, has a taproot that often attains a weight of 100 pounds. Such a reservoir of food and water enables the "man-of-the-earth" to thrive in a region where rains may be extremely limited.

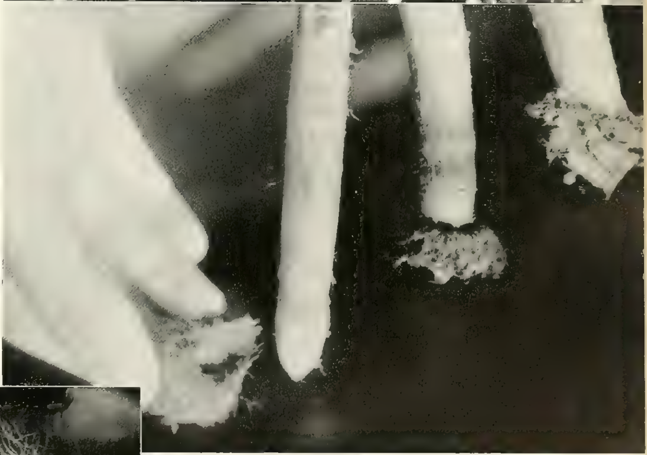
The normal life-span of any plant is directly related to the life-span of its roots. So-called annuals have roots whose duration is but a year; whereas perennials can live almost indefinitely. In between these two are the biennials—plants like the carrot—which live for only two years. Length of life of the



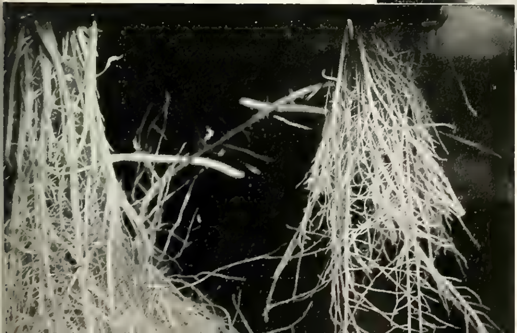
Plants did not always have roots. There was no need for them hundreds of millions of years ago when all life was aquatic. At left is the holdfast of a giant kelp. This crude mimic of the full-fledged root is purely an anchor and has none of the nutritional functions so important in land roots



The tip is the business end. It is the center of a root's growth, the "nose" and "sense of touch" which enable it to dodge impediments and find the best food



To prevent wear and tear of abrading soil on these vital probes, Nature has equipped them with special protective caps called calyptra. In the picture at right one of these thimble-like devices is being removed, exposing the sensitive tissue beneath

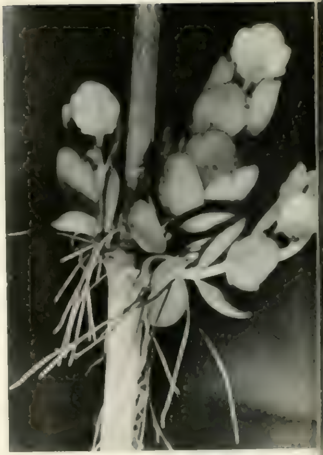


(Left) An "underground" view of a root system. These labyrinths of fiber belong to corn plants growing in nutrient solution. Fibrous root systems are amazingly long. That of a single oat plant which occupied a cubic yard was found to measure well over 450 feet in length

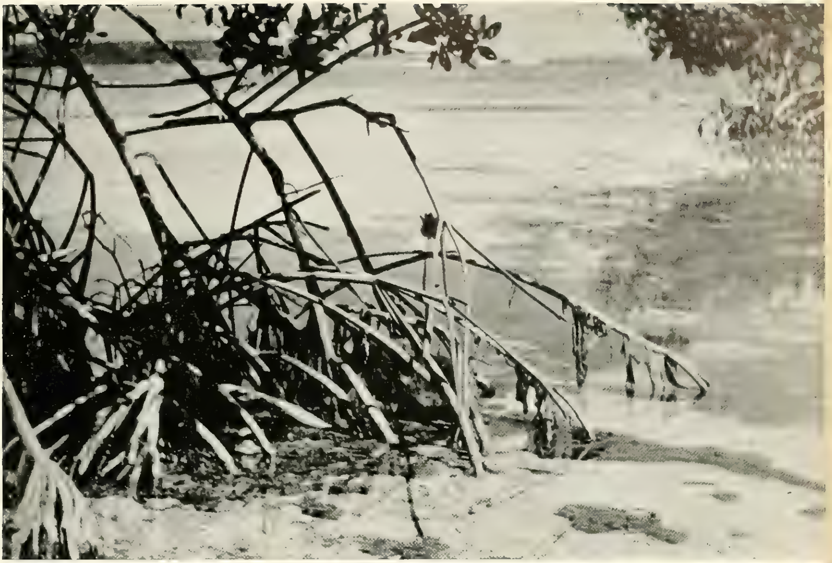
(Above) For stabilizing wind-blown dunes, nothing is better than a grass. This fibrous-rooted family has the ability to tie soil together, thus playing a great role in land reclamation and conservation

Otherwise top-heavy, the pandanus plant sends out prop roots from the main stem which are able to support it. So zealously do the prop roots perform their function that at maturity the main trunk has died away, leaving no other support

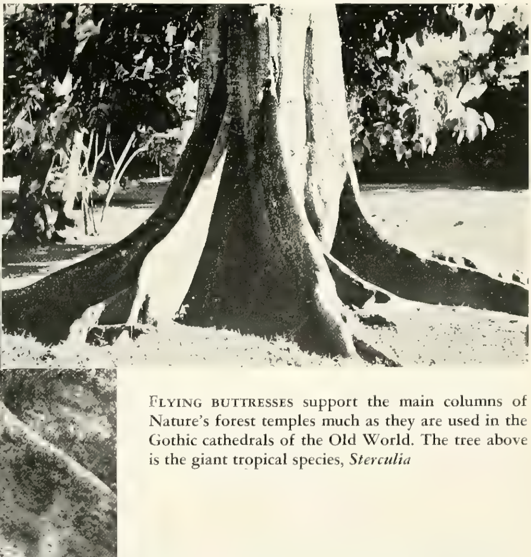
(Right) Shooting down into the ground at an angle, the innumerable prop roots of the palm *Euterpe* strengthen it against the winds that freely buffet its head about



(Above) A "live-forever." This zarre plant (*Bryophyllum crenatu* actually originates plantlets, compl with roots and leaves, high up on aerial portions of the parent. Here i spectacular example of adventitious r formation which enables plants to produce without flowering, a meth employed by many of our pernici weeds



MOST FAMOUS of all prop-rooted plants are the widespread mangroves *(above)*, builders of the Florida Keys. On a multitude of interlacing stilt-roots, the mangroves wade out through shallow water. The tangled roots gather all the tidal litter and thus build up land where once was water



FLYING BUTTRESSES support the main columns of Nature's forest temples much as they are used in the Gothic cathedrals of the Old World. The tree above is the giant tropical species, *Sterculia*

THE SILK-COTTON tree of the West Indies likewise boasts a set of buttress-like ridges which can see it through many a hurricane season. This is the tree which in its cultivated state yields the fiber known as kapok. It has large pods filled with cotton-invested seeds

1

[illegible] extent [illegible] climate, for the castor bean is perennial in its native tropics, but acts as an annual in temperate regions. Wheat that is planted in the fall (winter wheat) acts like a biennial, but always as an annual when it is planted in the spring (spring wheat).

Agriculture capitalizes on root structure, and growers who own dry farmlands well know that certain crops like alfalfa, because of deep roots, can exist where others would fail. On the other hand, taprooted plants are useless on loose soils which, always susceptible to erosion, need tying down. On such soils the fibrous root is the answer. Thus for stabilizing wind-blown dunes nothing is better than a grass, as you can see on any sandy seacoast.

Variety in roots is endless, especially in the group called "adventitious." The thing we think of first about roots is that they live underground, but there are many which have the strange habit of originating on leaves or stems. On these adventitious roots is based the whole foundation of plant propagation by means of layering and cutting. In this way the housewife "slips" a new geranium or begonia and thus short-cuts Nature. Actually she is merely copying Nature, which has long followed such practices. Many a shrub—forsythia, raspberry, or blackberry—arches its branches in such a way as to permit rooting at the tips. Similarly strawberries send out rooting runners, and the walking fern anchors its frond tips

2

in terra firma. Certain bizarre plants, such as live-forevers *(Bryophyllum)*, actually form plantlets, complete with roots and leaves, suspended on the aerial portions of the parent. This type of adventitious root-formation, of course, supplements seed production by enabling plants to reproduce without flowering, and many a pernicious weed is such because of this free rooting behavior.

Not all abnormal roots are for reproduction, however. Native Indian corn, though husky enough above ground, is invariably top-heavy, being supplied with a rather weak main root system. But Nature comes to its aid by early sending out peculiar roots as props. Palms, screw pines *(Pandanus)*, and many another tropical plant with a heavy crown that is freely tossed about by the wind, have to develop so-called "prop roots" of this sort as stabilizers or shock absorbers. Such roots commonly spring out from the stem above the ground and then penetrate the surrounding soil, burying themselves at a 45-degree angle. Special fibrous tissue is developed in prop roots, and this is arranged in such a way as to resist powerful strains caused by the wind. At the same time the tissue is so highly elastic that in any kind of breeze its spring-like, supple resilience is sufficient to force back the bending plant into its correct vertical position. Prop roots are more common in the tropics, especially in regions where very wet soils make normal roots precarious.

At maturity plants like pandanus have, indeed, nothing but prop roots, the main trunk having died away. Most famous of all prop-rooted plants are the widespread mangroves *(Rhizophora)*, which have the habit of sending out multitudes of freely branching stilt-roots. The formation of these is so rapid that the mangrove trees might almost be said to walk through the shallows upon their interlacing stilts, which hold in their grasp all the litter of the tidal flats. Land inundated by shallow seas is thus reclaimed. In southern Florida hundreds of "keys" owe their origin to the reclamation work of mangroves, whose rootstalks can resist the undermining action of wave and tide.

Another form of root that serves as a prop is not cylindrical, but flat, and resembles the great flying buttresses of continental cathedrals. Indeed, these roots serve the same purpose, for they hold up the main columns of Nature's cathedral spires—the heavy, cumbersome canopies of giant forest trees. "India rubber" trees *(Ficus elastica)*, when fully developed in their homeland, have tremendous boles which are supported by amazing tabular roots, look-

1 YOUNG BANYAN trees use pillars rather than buttresses to solve their architectural problem. Rigid roots grow down from the heavy branches to the ground. The banyan is a first cousin of the India rubber tree

2 APPEARING first as stringy "chandeliers" somewhat resembling Spanish moss, these pillar roots continue to grow throughout the tree's life, which may last 1000 years or more

3 PILLAR ROOTS, firmly fixed in the ground. Unlike true prop roots, they are extremely resistant to bending. As dutiful children, they support the parent banyan when it most needs their help

4 MATURE PILLARS. A really old banyan tree with its many offspring resembles a whole forest. One such titan boasts a leafy crown 2000 feet in circumference and is supported by 3000 pillars

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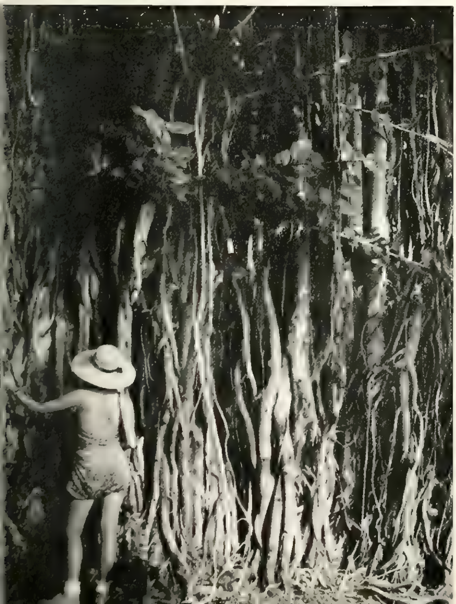

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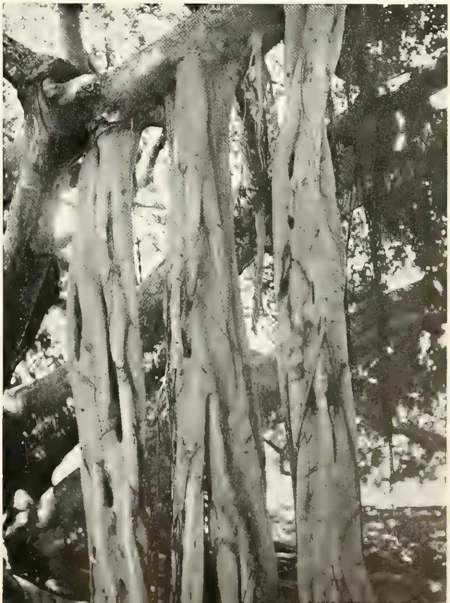


[illegible] plants [illegible] all directions from the same [illegible].

The banyan (Ficus bengalensis), a close cousin of the India rubber tree, extends the canopy of its lofty crown not only horizontally but [illegible]. Its great, thick, heavy boughs send out so-called "pillar" or "columnar" roots. Unlike true prop roots these [illegible] to budding [illegible] pillar [illegible] dangle nearer and nearer to earth until they finally root in the soil. Thus when the parent limb most needs help she can depend in a human fashion on her offspring for ample support. The columns continue to grow throughout the whole life of the parent (which may be upwards of a thousand years), and a really old banyan with all its many pillars, resembles not a single tree but rather a forest of trees. At Calcutta is a lusty youngster of 100 years, whose main trunk is 42 feet in circumference and which possesses 232 additional pillar root trunks, some attaining a girth of ten feet. Tradition states that Alexander the Great camped his army under a banyan whose leafy crown today measures 2000 feet in circumference and is supported by 3000 "trunks."

When left to themselves these giant trees [illegible] develop great numbers of columnar trunks, because under the dense leafy canopy of the mother plant the soil is usually too dry and hard for hanging roots to penetrate. The banyans or "Indian figs," known as the *asthatta (Ficus religiosa)*, are sacred to the Buddhists, who assist Nature by steering the descending roots into hollow protective bamboo poles and thence into well-broken and moistened soil. At Dena Pitya on the island of Ceylon there is said to be an old *asthatta* tree whose canopy shelters a village of 100 huts.

By means of roots many kinds of plants are enabled to climb. Certain so-called "ivies" possess roots of this category, in particular English ivy, poison-ivy, and the trumpet creeper. A close look at the stem of any of these three plants will reveal tiny, stubby outgrowths on the shaded side of the stem, which attach themselves to a wall or other support with such strength that the weight of the vine scarcely ever breaks them loose. Climbing roots never gather food, but are only for attachment. Indeed, if they fail to grasp or to touch their "ladder" they quickly shrivel and die.

The so-called "air plants," which grow upon other plants instead of in the ground, possess attachment roots which hold them tightly to their aerial seats. Many of these epiphytes absorb all their nutrients from the air. Others, collecting vegetable debris among their rosette leaves, send out peculiar adven-

(Below) Tiny, stubby climbing-roots of English ivy. *(Right)* Epiphytes cling aloft without ground roots. Unlike parasites, their attachment roots do not sap their host's vitality. *(Anthurium palmatum)*

titious feeding roots from the stem into this happenchance "soil." Epiphytes are not always small plants, but are sometimes actual trees. The tropical clusias start life as youngsters high up in the crotch of a tree, where their seeds have been deposited by some bird. Then in order to get enough food to grow they eventually find it necessary to tap the principal storehouse of supplies, the ground, and they send down long aerial roots as pipelines. These cables are as tough and as pliant as a rope and make fine ladders or swings for the plant explorer who needs to climb in tropical forests. Unfortuntely clusias and their cables have a habit of fusing together around the trunk of the supporting tree, and as more and more of these festooning ropes amalgamate, the host finds itself encased in a living strait jacket, which over a period of years eventually strangles it.

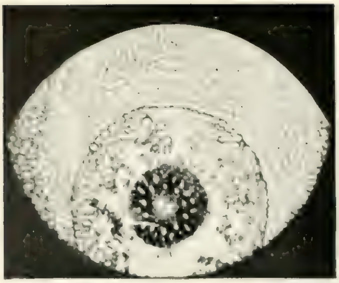
The tropical orchids boast the queerest root modifications among epiphytes, for besides acting as binding organs the roots of the aerialists have a most peculiar blotter-like covering, velamen, which spongelike, can soak up atmospheric moisture. In addition some orchid roots even function as leaves and manufacture food—an unheard of feat in the realm of normal roots. Chlorophyll-bearing roots of this type reach their most spectacular development in *Taeniophyllum*, an epiphytic orchid which is "all roots" and has no leaves and stems at all.

The layman frequently confuses epiphytes with parasites. The latter actually draw upon the supporting plant for nourishment. This is an easy mistake, for air plants certainly look like parasites when growing on their treetop perches. However, an examination of their root system shows that the epiphytes lack any penetrating sucking apparatus. Parasitic plants always possess this equipment, and life would be impossible to these jackals of the plant world without it. Their root adaptations are remarkable.

The mistletoe is as typical of the parasites as any. Birds distribute the sticky seeds. Upon germination on a tree limb, these seeds sink the queerest of roots into the living tissues. Their root system resembles a many-tined rake, each tooth or sinker of which represents a sucking organ that can tap those pipelines in the living tissues of the host, through which are pulsing the foods so laboriously manufactured. As this rake-like affair develops in size so does the external green foliage of the mistletoe, until a time is reached when there is no hope of eliminating the parasite,—for every time the exposed part is hacked away, the roots send up a half dozen different new plants to take the parent's place. Even more degenerate than the woody mistletoes are the herbaceous dodders—those orange twining vines that are so com-

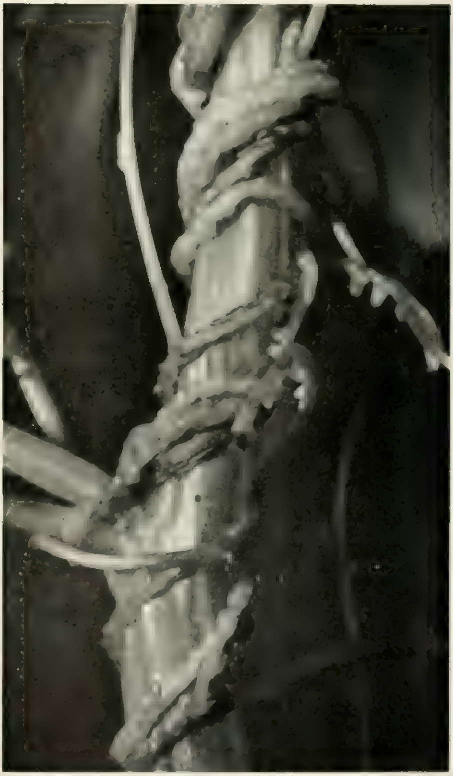
(Below) PECULIAR feeding roots creep out into the debris in the rosette base of *Anthurium hookeri*

TREETOP clusias send these aerial pipelines to earth for food. Sometimes they strangle the host



(Left) WHITE blotter-like velamen covering the aerial roots of an epiphytic orchid. Above is a cross-section showing the loose outer cells which can soak up moisture from the atmosphere. Some orchid roots even function as leaves and manufacture food—an unheard of feat in the realm of normal roots.

Below, by contrast, is a true parasite, the octopus-like dodder vine, siphoning the life juices of a jewelweed by means of penetrating knob-like roots.

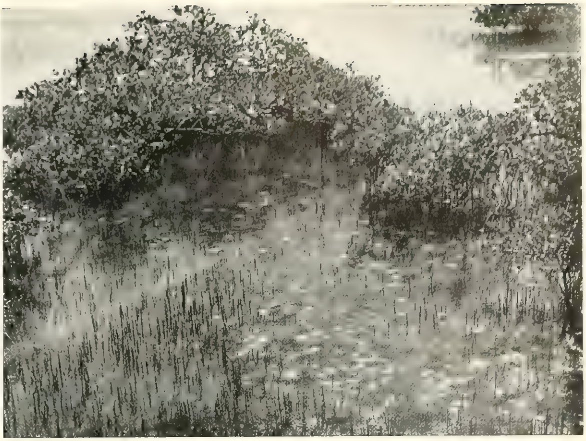


[illegible] Total inability to manufacture food—as is shown by the lack of green chlorophyll—makes it even more necessary for the [illegible] plant to [illegible] living host. Look at a mature dodder and you will see how its penetrating knob-like roots enable this parasite to siphon the life-juices of any herb so unfortunate as to be grasped in its octopus-like grip.

Like all living things, plants need and breathe oxygen in order to live; and every portion of a plant takes in oxygen, even the underground root. When soils become too compacted or if water stands upon normally well-drained soils, plants develop poorly and are apt to die. The roots have been drowned. But some trees, with which many of us are familiar, cannot be drowned. Like divers they possess air hoses which keep their submarine growth-activity continually supplied with fresh air. The bald cypress *(Taxodium)* of our southern swamps has just such an apparatus, enabling it to live in soil and water low in oxygen and often charged with deleterious gases. From the muck of their swamps, cypress roots sprout off and send up peculiar conical outgrowths known as "knees," which stand well above the water level. The bark of these natural ventilating systems is spongy and is filled with air spaces which allow oxygen to pass freely to the submerged portions of the tree. Black mangroves *(Avicennia)*, living in salty tropical swamps, have similar organs which, though much smaller, are more numerous than cypress knees. These stick up like so many fingers in the shallow tidal water.

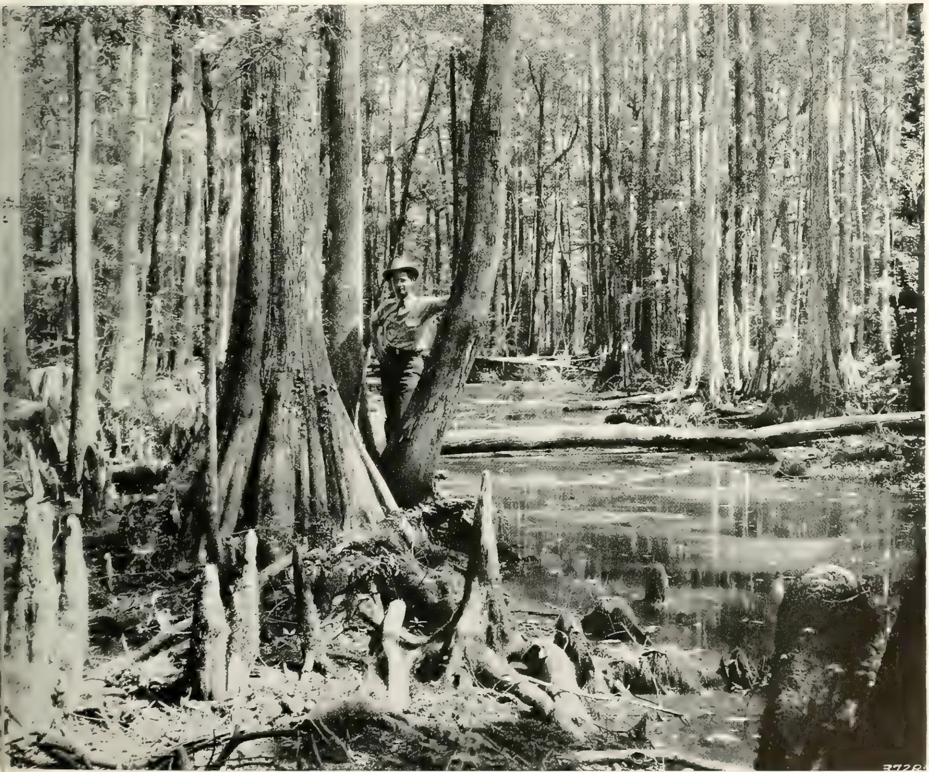
Roots are as variable as Nature herself. When they form a normal underground system they act as the plant's support and assure it of a constant water supply. As migrants out of their natural earthy element they may prop, climb, bind, parasitize, or fend for themselves. They may even set up natural "air conditioning" systems.

(Right) BLACK MANGROVES, with their finger-like aeration roots growing out of a salty tropical swamp. These roots supply oxygen to submerged sections of the plant and prevent drowning



(Below) CYPRESS KNEES: natural ventilating systems. These peculiar conical growths sprout off from roots that are in water or soil low in oxygen. Their bark is spongy and filled with air spaces. Thus they can convey oxygen to submerged portions of the tree and enable it to grow even in swamps charged with harmful gases

U. S. Forest Service photo by B. W. Muir



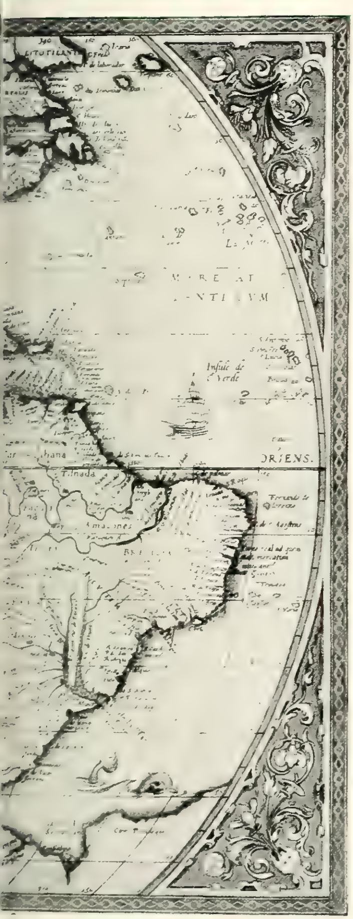
The Story of our

MAP

The epic of North America takes on new meaning when we examine the maps the early navigators and pioneers were forced to rely upon when they ventured into the unknown

By Irene F. Cypher

The American Museum of Natural History



"If you wish to sail from one port to another, here is a chart, and a straight line on it, and if you follow carefully this line you will certainly arrive at your port of destination. But the length of the line may not be correct. You may get there sooner or you may not get there as soon as you expected, but you will certainly get there." Such was the instruction given by the great map maker Mercator, on his Famous Chart of 1569.

For years we have all diligently learned that Columbus discovered America in 1492, and unconsciously in the recesses of our minds we believe that following this event of world importance the map of the New World sprang full-grown into existence. Actually Columbus was probably not the first European to touch the New World. The Norse were familiar with Greenland several centuries before and had probably reached the continent. And as for the map, several hundred years were to elapse before it was to begin to assume its now familiar outlines. Today we watch the map of Europe undergoing rapid changes. Such changes pale into insignificance when compared with the really radical changes in maps which followed in the wake of that epic voyage by Columbus. Adventure, romance, discovery, exploration, a mixture of knowledge and misunderstanding, a dawning realization of the extent of the great New World, and finally the complete picture, correctly drawn and with missing details supplied by pioneers, adventurers, settlers and serious map makers—this is the story of the New World map. And a curious story it is, too.

Many of the so-called "primitive peoples," whose cultures may be studied in the collections at the American Museum of Natural History, made and used more reliable types of maps than did the explorers and navigators of Europe in the fifteenth and sixteenth centuries. This is particularly true of tribes which led a wandering life. Arctic explorers have frequently been grateful for rough maps made by Eskimos. The Montagnais and Nascapi Indians of Labrador had a facility in drawing maps on bark. Islanders of the Pacific region were equally facile in certain forms of cartography. The Marshall Islanders in particular made odd "cane charts" which were remarkably accurate guides for sailing in and among the islands. Captain Cook had good reason to be grate-

(*Left*) South America was badly out of shape in this map, but the Gulf of Mexico is fairly accurate. The Aztec emperor Montezuma gave Cortez a map of the Gulf Coast, which may have contributed to the accuracy of this one drawn by Ortelius in 1570

[illegible]

[illegible] them in their journeys along the coast of Europe. [illegible] discoveries of the fifteenth, sixteenth, and seventeenth centuries and which produced the first known maps of the New World.

This Golden Age, during which the great map makers of the Flemish, French, and English schools flourished, was one in which accuracy often suffered for the sake of art. The maps made then were ver- [illegible] Indeed they were so beautiful that great painters such as Jan [illegible] grounds in many of their paintings. When you stop to realize how long it was before information brought back by the explorers of the day could be verified, you can understand and forgive these cartographic workmen if they filled in the unknown spaces on their maps with strange animals and took liberties with shore lines.

Columbus himself believed that the land he had come upon was a series of islands off the shore of Asia, some of which were so large and so situated that they [illegible] India. He must have had some personal doubts of his map-reading ability, for on June 12, 1494, during his second voyage, he made all in his party swear before a notary that the land they had just touched (Cuba) was the mainland of Asia. Even the map maker Juan de la Cosa, who was with him, signed this fantastic oath. The penalties for not signing were a monetary fine or the possibility of having one's tongue slit every time he denied the statement.

How America got its name

As information about the new lands slowly filtered back home, the map makers in Europe were kept busy [illegible] Martin Waldseemüller in 1507 first affixed the name [illegible] It was a Latinized version of Amerigo Vespucci, the name of a Florentine voyager whose travels have not been completely verified even today. Waldseemüller in another map made in 1513 omitted the name "America" and called the section "Terra Incognita," but the first name persisted and proved popular. Mer- [illegible] continents.

From this time on, the outlines of the New World began to take more accurate delineation, thanks to the explorations of the Cabots, Cartier, Balboa, Magellan, Cortez, Pizarro, and Coronado. From the reports of Cortez, Ortelius was able to give us an excellent [illegible] sive use of a map of the Gulf Coast which had been presented to him by Montezuma and was painted on a material known as *nequen* cloth. Indeed, the Spaniards found many kinds of maps in use among [illegible] In Peru they found not only survey maps but relief maps of the empire of the Incas. Legend has it that when the ninth Inca (about 1190) conquered a district and wanted to colonize it, he would have relief maps made for study purposes, and these are said to be the first relief maps on record.

South America seems to have presented less of a problem to the map makers than did the northern continent. The majority of the early maps show a South America of the relative contour and size we recognize today. For some time the southern part of Chile was less accurately drawn than the northern and eastern coasts of South America, until the hardy mariners of the clipper ships sailed their vessels around the tip of Cape Horn and up into the Pacific. In addition to bringing back silks and furs, they brought back information about the Pacific regions and the western coast line.

The Island of California

It was the northern continent that presented the strangest problems to the European map makers, particularly the regions of modern Alaska, California and northern Canada. It is not surprising that early travelers in these sections encountered difficulties when they tried to follow the maps of the time. An early map of the Western Hemisphere by Sanson, the French cartographer (probably about 1630), distinctly shows Lower California as an island, although Ortelius in his world atlas published in 1570 clearly indicated it as a peninsula, as did Mercator in his maps. This difference of opinion is reflected in maps of lesser known makers, and one wonders whether the explorers of that period tossed a coin to decide which map maker was correct. Practically all maps of the latter part of the seventeenth century show Lower California as an island, and it remained for Guillaume Delisle, the great French cartographer, to designate it positively as a peninsula in 1700. The French were more scientific and exact than the Dutch in their drawing of maps, and Delisle had accurate information supplied by Father Kino, a padre who had traveled overland to California, and who could therefore speak firsthand. We will never know how many early voyagers were misled by incorrect maps, and it is interesting to speculate on the difficulties encountered by unsung heroes who tried to find the "Island of California" and whose exploits vanished with them in their fruitless search.

The elusive Golden Gate

Today San Francisco and the Golden Gate seem almost synonymous, and yet for years none of the reports or maps of the early explorers so much as hinted at the possible existence of the Golden Gate. We know definitely that Sir Francis Drake spent 30 days in the vicinity of what is now San Francisco, yet he makes absolutely no mention of the famous bay and cliffs. The first actual mention of the Golden Gate appears in a navigator's report in 1768. Geologists assure us that the formation of the Golden Gate dates from far back in the geologic past, so perhaps Drake and other navigators failed to include it on their maps because they could not see through the fogs which sometimes enshroud it. Even Jodicus Hondius, in tracing the voyages of Drake from 1577-1580, inserted an inscription which has been translated as follows: "Someone will probably wonder that in this map we have left the face of the earth bare, but since it is our purpose only to represent the voyages of Francis Drake and Thomas Cavendish, it seemed unnecessary to describe the interior of the earth back from the sea coast, nor can all the names along the shore well be put down for want of space, since the shore is usually occupied with tracing the voyages on the sea. Wherefore let it suffice the reader if we mention the places seen by the navigators. . . ."

The mapping of the Pacific region involved the Spanish, English, and Russians, and the entire story is a fascinating romance. A map of 1535 made by Hernando Cortez showed the coast of Mexico and the lower tip of California. Other maps followed as a result of expeditions by Vizcaíno, Drake, Bering, Cook and Vancouver. The search for pearls, furs, commercial supremacy, and colonial conquest all contributed to more accurate maps. Of course for years progress in accurate mapping was retarded by a tenacious belief that the Atlantic and Pacific were relatively close to each other. This idea is evident in the maps of the colonial days, which fail woefully even to approximate the width of the North American continent. It is also responsible for the famous "sea-to-sea" grants which were a part of so many colonial charters. It took a long time to dispel hopes of finding that shorter route to India and China, that dreamed-of Northwest Passage!

One wonders what dreams of wealth and empire were aroused by the announcement of Vitus Bering, a Dane sailing in 1728 under the patronage of Peter the Great of Russia, that there *was* a sea to the east of Asia. A map exists today, made by Gerhard Müller, a German in the court at St. Petersburg, which makes direct claims to Russian possession of these New World regions, and which indicates a sea now known as Bering Sea. It is said that many manuscript maps still exist which were made as a result of Russian expeditions of this period, and still await publication. Spanish, English, and Russian maps of this region show considerable variations of latitude and longitude, although by 1800 most of the important places had been located. A map published by the Spaniard Navarrete in 1802, was used up to 1850, as were the charts of Vancouver and Arrowsmith, Englishmen of the same period, who based their work on this Navarrete map.

Vanishing isles

Even today the Pacific presents problems for the map maker, in the form of "disappearing islands." These are tiny portions of land which apparently are submerged for varying lengths of time and whose existence is consequently somewhat problematical. One of these islands is in the Tonga Group and is known as Falcon Island. Another is an island about midway to Hawaii that is recorded on some of the very earliest charts of the Pacific. It is said that the warship *Levant,* on which the hero of *The Man Without A Country* was imprisoned, was finally wrecked here. But the island itself has not been seen of late years. There are other islands of this type scattered throughout the Pacific, and map makers would have a jolly time keeping record of some of them as they appear and then disappear.

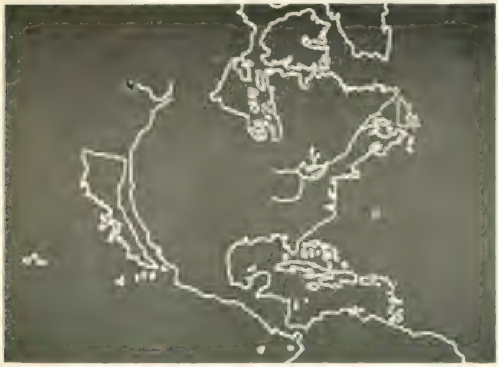
Of course, the first maps of this New World were those of sections along the Atlantic coast. The early expeditions of Sir Walter Raleigh resulted in the first known map of Virginia. Then John Smith in 1608 sent to the London Council a "mappe of the Bays and Rivers" of Virginia. There is a story to the effect that Henry Hudson had a copy of this map with him when he, too, started to seek the Northwest Passage. This same map was also referred to in the settlement of the boundary claims between Virginia and Maryland as late as 1873. Smith also made a trip farther north and in 1616 published his "description of New England." The Pilgrims knew this map, and they retained his name for the section. In the upper left-hand corner is a picture of Smith, designated "The Portraictuer of Captayne John Smith, Admirall of New England."

Naturally the maps of the early days reflect the

A *New* Continent

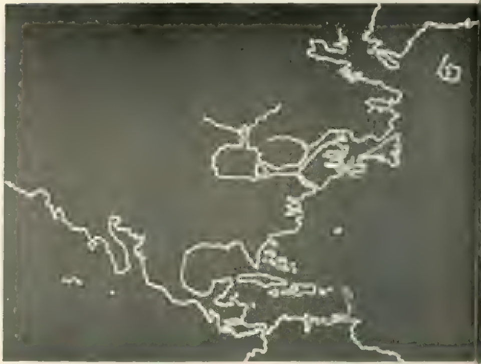
1531

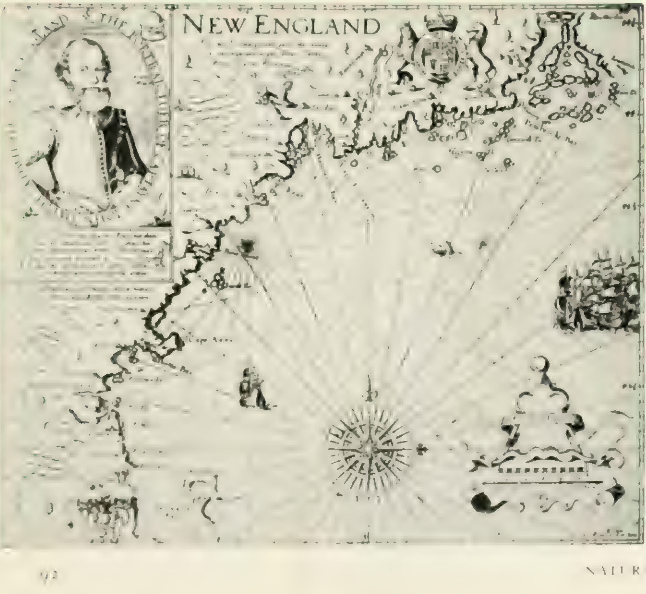
LOWER CALIFORNIA was an island, and a large inland sea in the Great Lakes region was imagined. Yet Hudson Bay, so remote from modern centers, was fairly well defined



1584

THE MAP DRAWER has rightly joined Lower California to the mainland but has added some new mistakes. The inland sea is expanding westward and northward, while Hudson Bay has been lost entirely





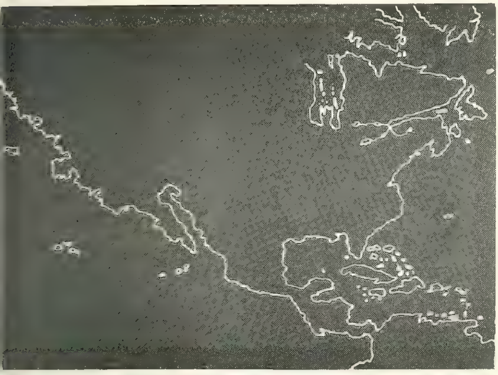
(Left) CAPE COD was called Cape James *(lower left)* on John Smith's map of New England, published four years before the Pilgrims landed. Plymouth, directly west of Cape Cod, is among the few names on this map that remain today. Latitudes are quite accurate. But if a modern navigator followed it for longitude he would expect to run aground on the North American continent 1300 miles out in the Atlantic

(Right) THE WESTERN AND NORTHERN coasts of North America were the last to be mapped. The important voyage of Vitus Bering in 1728 proved that Asia and America are separated by a narrow strait, which now bears his name. On this map dated 1758, the coast of Asia is fairly exact, but Alaska has not yet taken form. It is designated "Land of which one claims to have indications from the inhabitants of Kamchatka. Some maintain that one can see it from the Isle of Bering"

Takes Shape

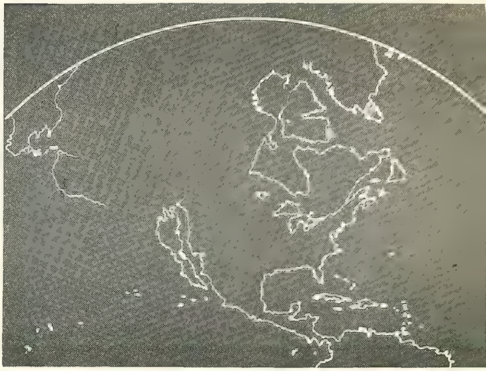
1587

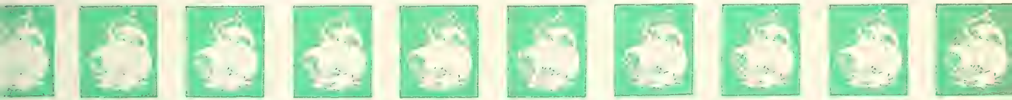
The inland sea has been erased in favor of some scattered bodies of water which hardly do justice to the Great Lakes. Hudson Bay reappears in the wrong shape

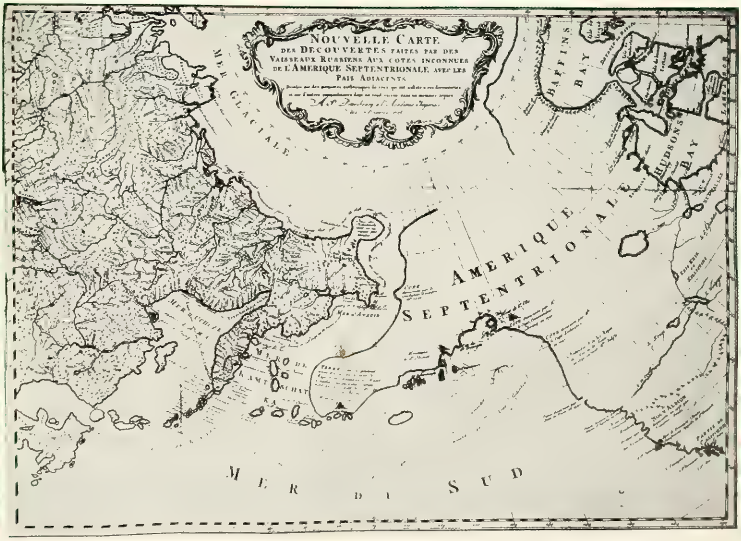


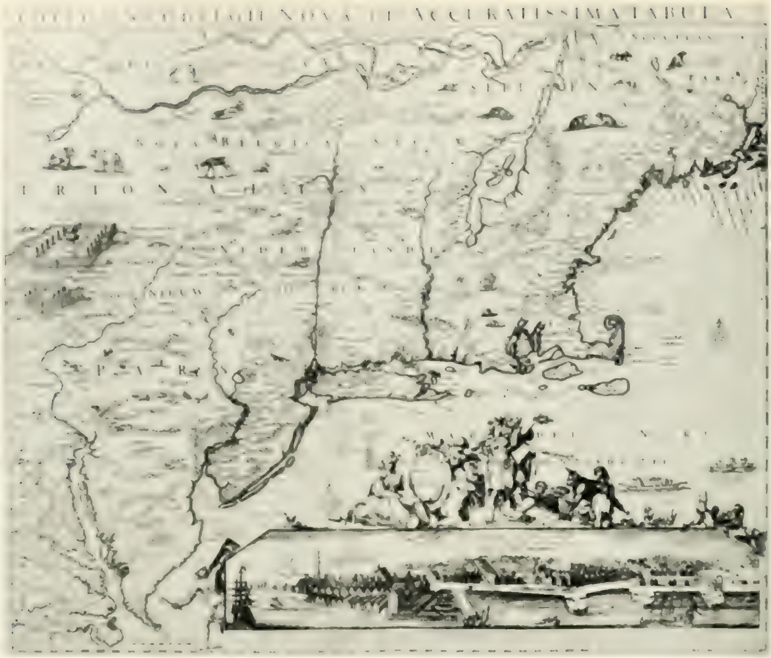
1686

The Island of California is resurrected, but the Great Lakes take some semblance of their proper form. The close proximity of North America and Asia is indicated, but far south of the proper position






NOUVELLE CARTE
DES DECOUVERTES FAITES PAR DES VAISSEAUX RUSSIENS AUX COTES INCONNUES DE L'AMERIQUE SEPTENTRIONALE AVEC LES PAIS ADIACENTS
MER GLACIALE
BAFFINS BAY
HUDSONS BAY
AMERIQUE SEPTENTRIONALE
KAMTCHATKA
MER DU SUD



This 18th century Dutch map exhibits a fine degree of artistic skill, both in hand lettering and pictorial decoration. The sketch at the bottom shows the early nucleus of the largest city in the Western Hemisphere. A number of soldiers and strategically placed cannon guard New York's water front

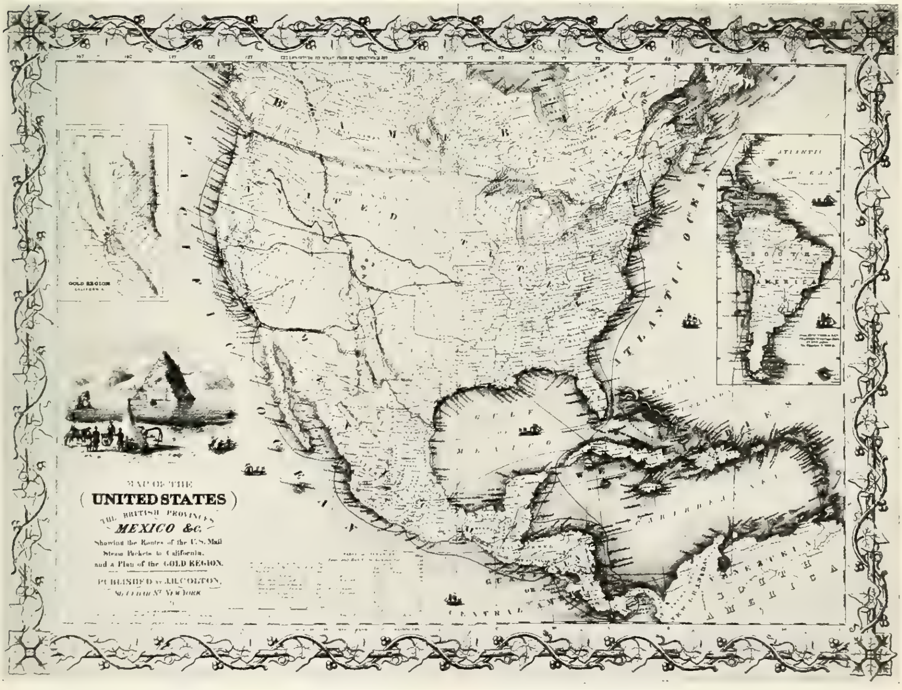
[illegible] which was the thing of the day. Often the nationality and allegiance of the map maker determined the facts portrayed in his maps. Even Delisle in a map of 1717 of the Louisiana and Gulf regions, in which he traced the rival Spanish and French claims, gives more weight to the claims of the La Salle expedition than to the De Soto expedition of some 145 years earlier. Delisle did, however, give a fairly correct delineation of the Mississippi River and the Appalachian and Rocky Mountains. Another Frenchman, Champlain, although he relied more on a well-trained eye than on absolute mathematical calculations, gave so accurate a description of the St. Croix River that the arbitration commission of 1794 was able to determine part of the eastern boundary of the United States, proving that his St. Croix was what they knew as the Schoodic River.

These early maps, although concerned with the New World, were all printed in Europe. It remained for one John Foster of Boston to make the first map printed in America, in 1677. It was of New England and was a woodcut. As first printed in Boston, it referred to the White Mountains as "The Wine Hills," an error which was corrected later in an edition printed in London. Slowly but surely American map-making began to come into its own. One finds the names of Lewis Evans, John Mitchell, James Turner, Washington, Jefferson, Hill, and Hutchins in the roster of contributors to the making of the map of the United States. Benjamin Franklin himself, famous for so many other things, is responsible for the first map or chart of the Gulf Stream. A cousin of his, Captain Folger, was in command of one of the mail packets from London, and the information which he supplied enabled Franklin to chart the course of the Stream. Ships following his chart were able to save at least three days in their sailing time across the ocean.

The establishment of the new government meant that new territories must be mapped and state boundaries fixed. Many of the original grants and charters were woefully vague, and the conflicts were legion. If one were to consult the well-known "Bowle's One Sheet Map of New England" (1794-1798), he would see many indications of these boundary disputes. Only the Revolution itself is said to have prevented actual warfare between Vermont and New York over their common boundary. The western boundary between Massachusetts and New York was long in being settled. The boundary between Massachusetts and Connecticut was not decided until 1804, and it was not until as late as 1899 that the boundary of Massachusetts was finally agreed upon to the satisfaction of all.

Probably John Mitchell's "Map of the British and French Dominions in North America," published in 1755 in London, should be called of paramount importance to Americans, for it is remarkably accurate for the period and was the one used in Paris by the peace commissioners of 1782-1783. One might say it was the beginning of the map of the United States. Many maps came after it—with details filled in by courageous pioneers such as Lewis and Clark, Bonneville, Zebulon Pike, Walker, Fremont, and others. States appropriated considerable sums for state surveys. The General Land Office sponsored a series of maps of territories, and atlases of the maps began to be published. The most outstanding of these atlases was that of Henry Tanner, published in 1823. The maps in this were surprisingly accurate in some respects, yet even he indicated several large imaginary rivers on the Pacific coast, whose existence, course, and origin were still legendary as late as 1838. In common with other map makers he did not seem to realize that an extended flow from east to west was impossible because of the intervening Rocky Mountains. But to his credit it must be said that he expressed some doubt as to the validity of some of these features.

The Civil War demonstrated how sadly needed were accurate maps, and in 1878 the United States Geological Survey was created to conduct an accurate survey of the vast territories belonging to the Government. Scientific mapping has progressed steadily, and it is unnecessary here to refer to the really gigantic, skilled, and commendable feats accomplished by modern cartography. For real romance, however, and the thrill, even though it be vicarious, of watching the New World grow, get yourself one of the earlier maps. Pioneers explored and settlers colonized regardless of the lack of accurate maps,—or should we say "in spite of" the maps they had. Whichever the case may be, the story of ignorance, determination, frustration, and final achievement is plainly written for all who care to see and read the maps shown here and others accessible in libraries. And if you are tempted to sigh over the rapid shifting of places and names on your map today, stop to consider the plight of the citizen of, say, 1651. At least you can be sure of your latitude and longitude,—and that is *something* after all.



By 1849 our map accurately represents most of the outlines of the continent. This was the year of the great Gold Rush, so there is appropriately an inset showing the Gold Regions of California, as well as the routes of the steam packets to the West. Towns and cities were plentiful in the East, but the West contained many blank areas. The pioneer was still a long way from the accurate road maps familiar to all in 1942

STRATEGIC METALS

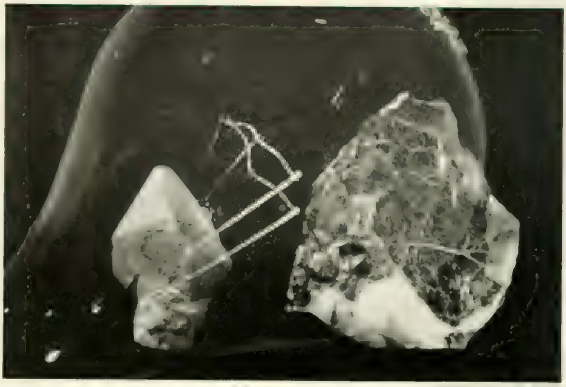
NUMBER 11

TUNGSTEN

The mineral which produces the hardest man-made substance and made possible Germany's "blitz" production of military equipment comes largely from the war-torn regions of the Far East

By Frederick H. Pough

T[illegible] the time of the Spanish-American War would not have included tungsten. For until 1900, tungsten had small use, and there was little or no commercial production before the development of [illegible] however, its consumption has increased rapidly, roughly paralleling steel production, with a steadily climbing percentage of tungsten to steel.



The mineral that hardens steel and goes into the best electric light filaments is found in two important ores: scheelite *(left)* and wolframite *(right)*

Tungsten is hard, dense, and silvery, and it has a melting point higher than that of any other metal—over 6100° F. This is so high, in fact, that tungsten can only be melted in an electric furnace, and in actual production and use it is never melted. Recovery from the ore is made in two ways: either an iron tungsten alloy is produced and then added to the steel, or the metallic powder is made by reduction with carbon of sodium tungstate, which has been made from the ore.

Tungsten steels have the remarkable property of remaining hard at extremely high temperatures. Even at red heat they are not softened. It will readily be seen that such material has a great advantage over ordinary carbon steel in machine tools. Formerly the cutting tool had to be kept cool and the casting turned slowly to keep any sort of edge on the tool. With the advent of tungsten steels, larger cuts could be made at higher speeds. It has been said that with tungsten steel cutting tools, [illegible] work of five men and five machines with ordinary steel.

Recently, tungsten carbide has been developed that is even harder than the tungsten steel, and more economical because it lasts longer. Tungsten carbide is the hardest artificial substance known, it is harder even than carborundum and approaches the diamond. Not only does it make a superior cutting tool for steels but it will also cut glass and porcelain, substances which other tools cannot work. Tungsten carbide cannot be fused. With cobalt as a binder, a finely powdered mass is sintered, that is, converted into a compact solid without actual melting. It lasts from 25 to 100 times as long as an ordinary tungsten steel tool.

The military uses are obvious. Hard covered armor-piercing shells are made with tungsten steels; gun breeches are made of tungsten alloys; and the big and little guns that often get red hot in action are lined with steel alloys of this strategic metal. Electric light filaments—the most obvious use to the ordinary man—absorb only about one and one-half per cent of the total production. Filaments use so little of the metal that a whole house with all the bulbs the manufacturers try to sell us, still contains only about one cent's worth of tungsten. But the greater efficiency of tungsten filaments over filaments of other sorts saves the public a tremendous sum.

Since tungsten is so hard to melt, the filaments of bulbs are made without ever actually melting the metal. The fine powder recovered from the final treatment is compressed, heated by the passage of an electric current, and hammered by centrifugal hammers until it becomes a solid mass. Once this is done it can be rolled and drawn, and as it is worked it becomes ever more ductile, until it can be drawn cold. The smaller the original particles, the finer it can be drawn. The final wire may be only 0.0011 inches thick—one-fourth as thick as a human hair. Pro-

TUNGSTEN
Production

longed exposure to high temperatures, as when the light is on, causes the particles to grow in size and make the spiderweb-like wire increasingly brittle. The filament will also oxidize at red heat and finally—poof! You have to get a new bulb!

Unlike tin, there are several ores of tungsten. Scheelite (a calcium tungstate) and wolframite (an iron tungstate) are the important ones. Ferberite and huebnerite are iron-rich and manganese-rich varieties of the latter mineral. In recent weeks several news items have spoken of a wolfram rush in Portugal. One suspects that the majority of reporters have not realized that wolfram is merely a European term for tungsten, and that they could have called it a tungsten rush. Wolfram and wolframite were derived from an old name applied to what was then an exasperating associate of tin ores, which in metallurgic terms "wolfed" the tin, reducing the yield.

In the foreign fields, wolframite is the most important ore. It is a common associate of tin, and it occurs in the same type of high temperature deepseated veins. One Cornwall mine produces a few tons a year. Under the stress of war conditions more is probably being recovered. A small deposit in France resembles the Cornwall veins, of which the area is a geological extension. Though figures for 1941 are not available, recent news stories would indicate that production in Portugal during the past year may have increased, as indeed it has here.

In contrast to most other strategic minerals tungsten has several ores and many sources. No continent completely lacks some sort of commercial deposit, though the larger ones seem to lie on or near the shores of the Pacific. In 1940, we imported nearly 11,000,000 pounds of concentrates, which contained almost 6,000,000 pounds of tungsten. A third of this came from China, a fourth from Bolivia. Several countries appear on our 1940 import list which were not there in 1939. Possibly the economic measures which were taken to insure our supply were beginning then to show up in importation figures. Four and one-half million of the 11,000,000 pounds came from this hemisphere, the remaining five and one-half million from the now gravely threatened East.

America's tungsten prospects are not dark, however, even with the present situation. Several factors ease our problem, the most important, perhaps, being the possibility of substituting molybdenum for tungsten in high-speed tool steels. Molybdenum in seemingly ample tonnage is available in this country. Secondly, the increase of our imports from South America suggests that that continent can supply a very considerable portion of the New World's needs. New compounds, like tungsten carbide, will use more efficiently the shortened rations. "A pound of tungsten used in carbide tools will cut fifty times as much steel as a pound of tungsten in a high-speed steel tool. Reports emanating from the Krupp Works, Germany, attribute the 'blitz' production of Nazi military equipment to the tungsten carbide (widia) tool."* There is little chance that increased reclamation will play a greater part, for the high cost of tungsten has always caused tool steel scrap to be guarded carefully.

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*The Mineral Industry during 1940, ed Roush (New York, 1941), XLIX, 619

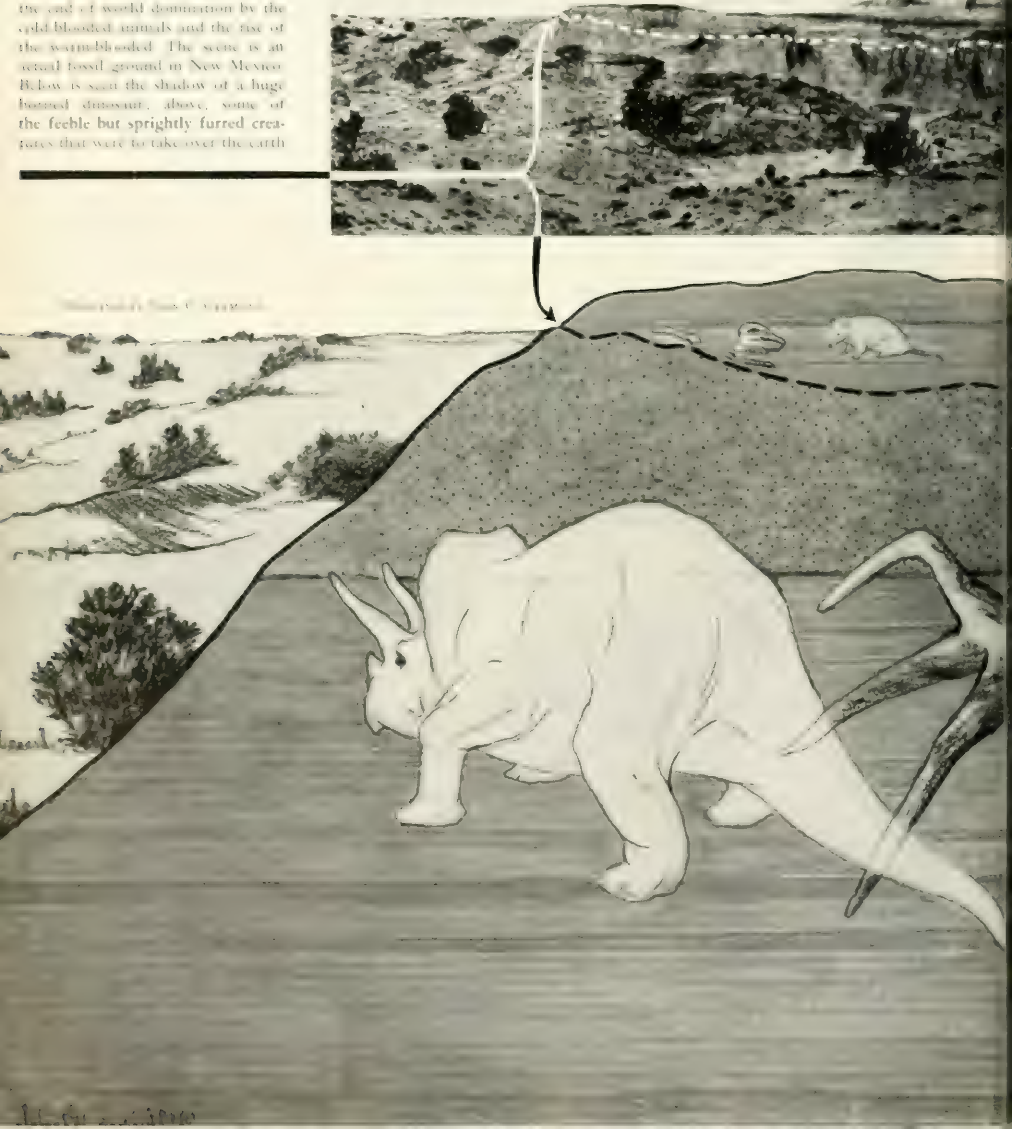
Continued on page 122

After dominating the world for millions of years
the dinosaurs come to an abrupt end and—

Th

By George Gaylord Simpson

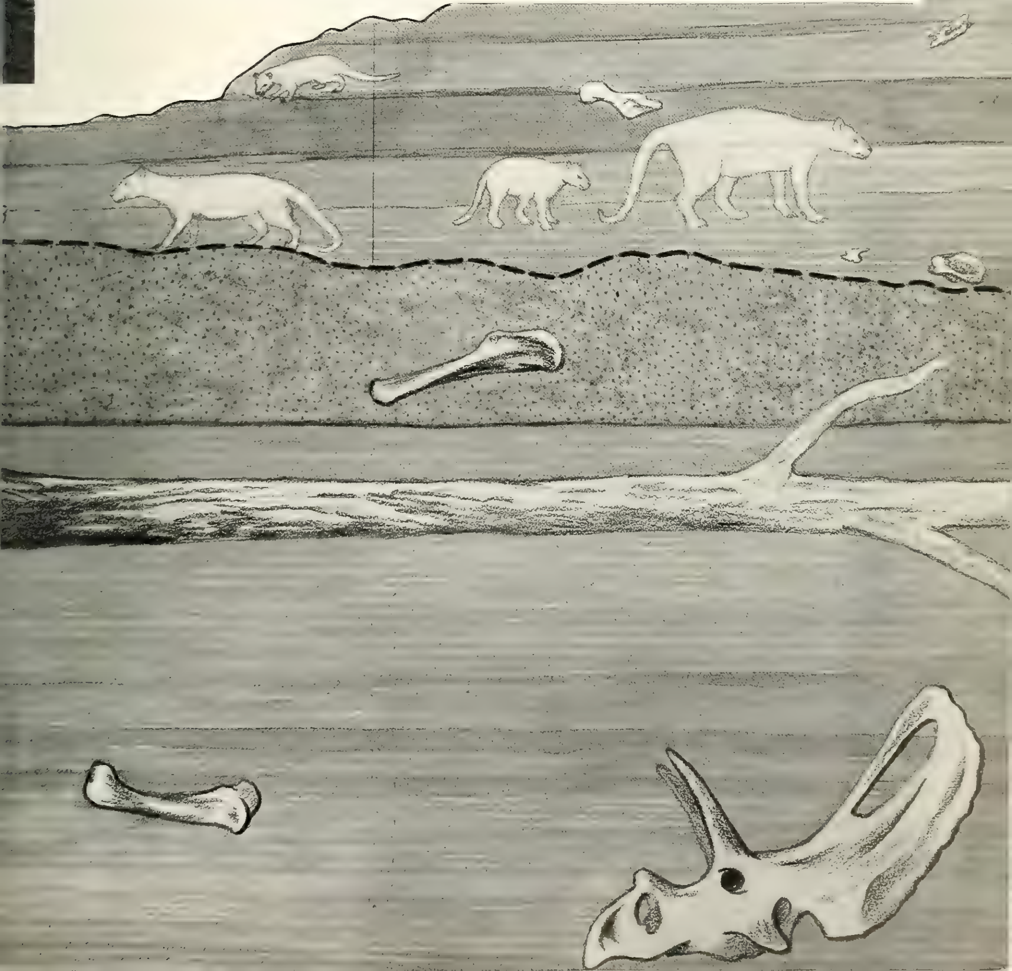
(*Right*) Death line of the dinosaurs. This dotted line marks the most dramatic and perhaps most important event in the earth's history. It shows the end of world domination by the cold-blooded animals and the rise of the warm-blooded. The scene is an actual fossil ground in New Mexico. Below is seen the shadow of a huge horned dinosaur; above, some of **the feeble but sprightly furred creatures that were to take over the earth**



meek inherit the earth

LET us take a walk in New Mexico. We shall start in the northwestern part of the state, near the ancient Indian ruin of Pueblo Bonito, and walk to the northeast, up a sandy arroyo, a watercourse now dry but subject to occasional brief, violent floods. Today the earth is parched under a burning sun, and the scanty sagebrush is dull green and dusty. The sand is blown into ripples and dunes in the bed of the arroyo, but along the slopes are bare exposures of yellow sandstone and delicately tinted clays, carved into curious forms by wind and rain. On a mound of lavender clay, we see a curious object, lying broken on the surface as if it had been buried and had been roughly washed out by one of the infrequent downpours. It looks like a bone, but it is much larger than the bones of any animal now living in the region, it is dark in color, and it is very heavy and hard. It is the fossilized thighbone of a dinosaur.

Continuing our walk up the arroyo we pass a thick series of alternating strata of hard clay and of sandstone, one above the other. At any one point the exposed thickness is only 20 feet or so, but as we go up the arroyo we pass successively higher and higher beds in the series until we have seen several hundred feet of vertical thickness. Pausing by a thick bed of coarse and rather hard sandstone, we find not only more dinosaur bones but also small conical teeth, recognizable as those of crocodiles, and shiny, lozenge-

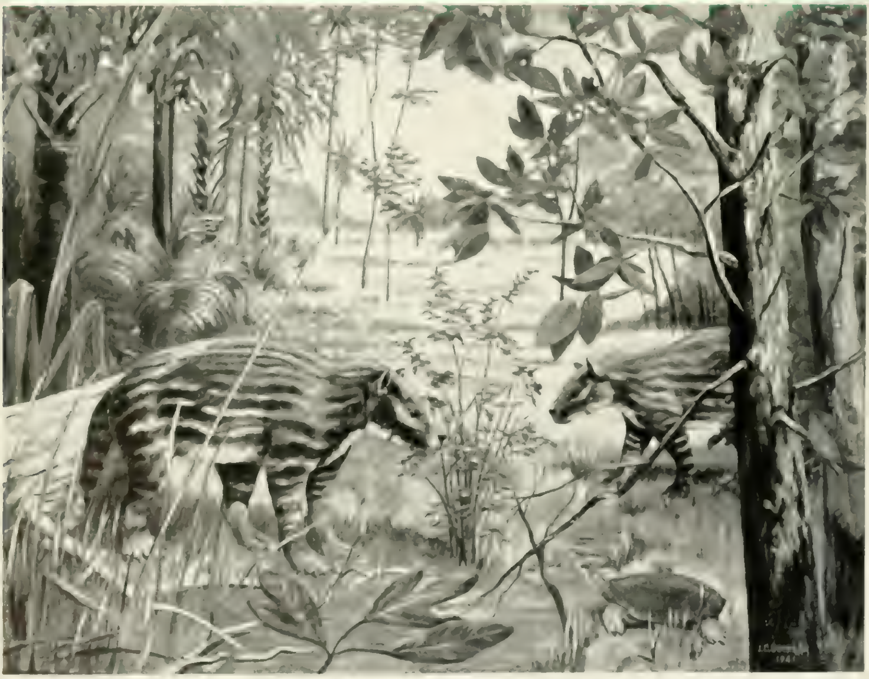


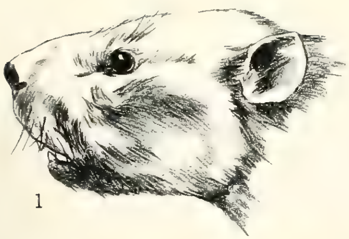
[illegible] that died more than 60 million years ago. What is [illegible] mud piled up until these beds were deeply buried, and as they compacted and hardened, the remains in them were mineralized and fossilized. Later, much [illegible] were brought to light, so that we now find on the sur- [illegible]

[illegible] world. We have also been walking through time, for as we ascended the arroyo, each higher layer in the piled-up series was deposited at a later time than those below. Each step upward may carry us onward ten thousand years in this record of the history of ancient New Mexico. We have traversed one or two chapters of the time of the dinosaurs, in which different species [illegible] each other without, however, ceasing to be similar. Let us continue up the arroyo, which means also to continue later in time, to see what the next chapter of the thrilling serial may be.

[illegible] sandstone proves to be sharply defined and very uneven. Filling the hollows in it is a bed of brilliant red clay above which, extending far above this to the northeast, is another thick series of red, gray, and green clays, with occasional lenticular masses of white or yellow sandstone. It looks as if the older sandstone had been eroded by the elements long ago and that after an interval fresh floods had deposited mud on [illegible] and

WHERE NOW there is desert, broad rivers meandered over fertile plains at the beginning of the Age of Mammals, 60 million years ago. The climate was moist and mild in the section of New Mexico depicted below, but mammals have since proved themselves so adaptable that there is almost no climate too rigorous for them. Thus they far outstripped the dinosaurs in adaptability. Below, a turtle—old-fashioned even in that day—looks up at a pair of condylarths (*Ectoconus*), prophetic of the new era





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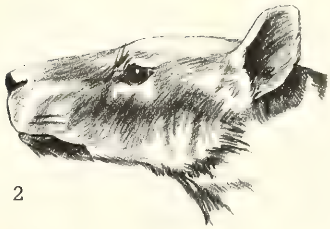

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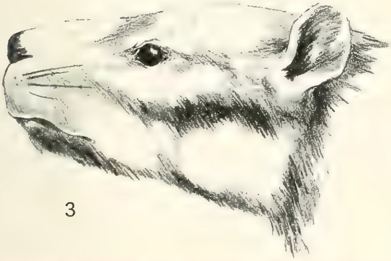

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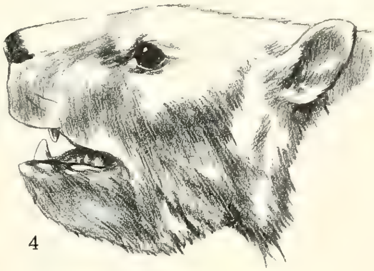


4

1 **Most multituberculates were mouse-like or rat-like, but *Taeniolabis* (about one-third life-size) was almost as husky as a beaver. This group gave way to true rodents**

2 **There were no exclusively meat-eating animals, but the creodonts were the nearest approach, of which *Loxolophus* was typical. (About half life-size)**

3 **The condylarths were herbivorous counterparts of the creodonts. *Ectoconus,* shown here at about one-third natural size, is fully restored opposite**

4 **Least promising were the taeniodonts, represented by *Wortmania* (about one-third natural size). Their descendants became specialized, then died out**

the red clay marks the end of one chapter and the beginning of another. We can put our fingers on the exact spot. Mark it well, because it is the visible record of the most dramatic event that ever occurred in the history of the world. Remote as it may seem to us, that was also the most important single event that ever occurred in our own history. If it had not happened, you and I, or anything human, would never have existed.

These upper, later clays look much the same as some far below. In what way do they represent a radical change in life history? Let us search them for organic remains. The most diligent scrutiny reveals no more of the great dinosaur bones. These are all gone, left one or two million years behind us, down the arroyo. But as we adjust our search to a different scale of magnitude we begin to find much smaller bones and tiny, many-cusped teeth, wholly unlike the dagger-like or serried teeth of the dinosaurs.

The hordes of bulky, cold-blooded dinosaurs are gone, vanished as if they had never been, and in their place are other hordes, even more numerous and varied but relatively insignificant in size and apparently feeble in comparison with the least of the lordly dinosaurs. The Age of Reptiles (the Mesozoic) has ended and the Age of Mammals (the Cenozoic) has begun.

The change here appears so sudden that it seems to give evidence for the old belief that the great reptiles, Rulers of the Mesozoic, were wiped out by catastrophic divine wrath and that the earth was repopulated by the creation of a gentler breed. But we now know that evolution, by and large, is a slow process and that when its results burst upon us with seeming rapidity they must be the culmination of long ages of preparation. So it is here. These herds of mammals that so quickly replaced the dinosaurs were not the first mammals to exist but were merely the first to become abundant and widespread.

Since almost the beginning of the Age of Reptiles mammals had existed. They had been small—a mammal larger than a rat was then a giant—and they had been obscure. Probably they were confined to limited areas and to peculiar environments where the competition with the omnipresent reptiles was not too lethal. The result is that they are among the rarest of fossils. Only here and there under exceptional conditions have their remains been found: in a limestone fissure in England, in a single quarry in Wyoming, and in wind-blown sands in the middle of the Gobi Desert. These and a few other discoveries show that mammals did persist during the dark ages of reptilian

[illegible]

[illegible] reptilian extinction at the end of the Age of Reptiles. [illegible] NATURAL HISTORY, [illegible] dinosaurs finally became too sluggish and too inadaptive to meet the conditions of rapid changes in [illegible]

The tiny, furry creatures that would have been the objects of scorn had dinosaurs been capable of that emotion, thus inherited the earth. They did so primarily because they were more adaptable. Their adaptability enabled them to survive the crisis of environmental change that slew the last of the giant reptiles. Once these reptiles were gone, this same adaptability enabled the mammals to multiply relatively rapidly and to adopt new modes of life, formerly closed to them by reptilian competition.

Definition of the word "mammal" means a great deal more than naming a few characteristics that enable us to recognize this kind of animal. We must [illegible] to take over the earth when the reptiles' long day was done. And out of this comes an explanation, partial at least, of why man himself was able to arise and to rule, for we are mammals, too, in one respect the mammals *par excellence*. The most basic mammalian character is intelligence. Small in size, without armor, without large fangs, the earliest mammals survived mainly because they used their heads. Unable to outfight dinosaurs, they outsmarted them. The essential upward trend in mammalian history is an increase in mental power, in grade of intelligence, culminating (up to now!) in man. There are, of course, relatively stupid mammals, and some [illegible] reptilian dodge of retreating into a shell; but the most stupid mammal is a mental prodigy in comparison with the most clever reptile.

The great majority of reptiles lay eggs, and all of them leave the young to fend for themselves from the start. The eggs may be spoiled by too cold a night or too hot a day, and eggs and young alike are peculiarly liable to attack by marauders against which their de- [illegible] bring forth their young alive, reducing the hazards of the embryonic period to a minimum. Without exception, the young remain with the mother for some time and are nourished with her milk and protected by her against enemies. This not only enormously increases the young mammal's chances of survival but also gives it a relatively sheltered juvenile period in which it can adapt, learn, and acquire behavior patterns more complex than the almost entirely instinctive reactions of the young reptile. This opportunity to learn is related to the ability to learn—no mammalian characteristic is an isolated thing, but all are intimately correlated to produce a higher type of physical and mental functioning. The complex of growing intelligence and of juvenile care also in- [illegible] mammalian sorts of conscious social structures, which again culminate in human society.

The more strictly physical structures and functions [illegible] ancestral reptiles. Mammals early acquired a com- [illegible] nearly constant body temperature. Thus they can survive and remain active in weather so cold that reptiles become dormant and finally freeze to death or in weather so hot that reptiles die of a sort of sunstroke. There is almost no climate so rigorous that [illegible] mals to survive the great dying time of the reptiles at the end of the Mesozoic. Greater mammalian activity is also forwarded by improved bony and muscular structure. A mammalian thighbone, for instance, is more finished and more specifically adapted to special functions than is the corresponding bone of a reptile. A skilled mechanic at once recognizes the mammalian bone as being a better job. The mammal is capable of faster, more continuous action.

All these things—suckling the young, maintenance of body temperature, sustained activity—require a more rapid and constant utilization of energy within the mammal's body. This higher metabolism also implies a more steady food supply and a more efficient use of it. The whole body is involved in these activities, but we see them reflected most clearly, especially when dealing with fossils which preserve only the hard parts of animals, in the changing structure of jaws and teeth. The complicated reptilian jaws are made of many different bones, mechanically complex but so put together as to permit only a limited repertory of motions. In mammals the lower jaw is a single bone, strong and simple, with very wide possibilities of movement. Dinosaurs could not chew; they could only rend and chop with their teeth. In conjunction with their new jaw structure, mammals early acquired a peculiarly potent pattern of cuspidate, or pointed, teeth. This pattern was amazingly adaptable. Emphasis on one element or another in the process of evolution could produce specialized jaws equipped to take care of the most extreme varieties of food, each with maximum efficiency. Thus the mammals could find plenty where many of the reptiles would starve to death.

Those are some of the reasons why the humble, furry, little mammals were able to inherit the earth when their great chance came—when the going became too hard for the stronger, more abundant, but clumsier, less efficient, and less adaptable reptiles. Of the dozens of different kinds of reptiles in the Mesozoic very few survived into the mammalian age of the Cenozoic. None of the biggest reptiles could make the transition. Those that did survive — lizards, snakes, turtles and crocodiles—had the fortune to be adapted to environments that changed less radically and to ways of life in which they were less at a disadvantage in comparison with mammals.

Let us return to New Mexico and see what life was like there at the beginning of the Age of Mammals. The climate was certainly more moist than it is now and perhaps more equable. Broad rivers meandered over the fertile plain that is now a desert, and groves of lush trees and shrubs abounded where scraggly sagebrush now grows.

Among the swarms of mammals, there is only one that is at all familiar to our eyes: a little opossum; for the opossum is the great conservative among mammals, an almost unmodified survival from the Age of Reptiles. The time is so remote that all the other animals have since either become extinct or have evolved into something unrecognizably different. It is difficult to describe these early mammals by any names derived from the recent fauna. It cannot be said that such and such an animal was an ancestral horse, because that ancestry was not yet sufficiently horse-like to be distinguishable, or that another animal resembled a cat, because the special cat-like habits and structures had not yet been differentiated. There is really no alternative to coining distinctive names for the ancient groups of mammals, and in this archaic New Mexican landscape most of the mammals we see are multituberculates, creodonts, condylarths, and taeniodonts.

Most of the little multituberculates were mouse-like or rat-like, although at this particular time some of them had achieved considerable size and were as large as husky beavers. They had enlarged, more or less rodent-like incisor teeth, and their cheek teeth were grinders covered with rows of tubercles—hence the name "multituberculate." The smaller kinds had also a set of large, sharp, scissor-like teeth in the middle of the jaw, for slicing off the skin and rind of fruits and vegetables. In that world the multituberculates played the part the ubiquitous rodents do in ours, but they were not true rodents. They were then the oldest type of mammal, a survival from the still dimmer past of the early part of the Age of Reptiles. Somewhere, as yet undiscovered, true rodents were probably even then beginning to evolve in obscurity. When their typical structure was well developed, they spread rapidly over the world. When this happened the multituberculates quickly became extinct without issue, for the habits were similar and the rodents were more efficient in the ensuing competition.

The carnivores and herbivores of today differ from each other so much that the thought of mistaking one for the other is ridiculous. Who could think that the fierce, flesh-eating tiger might be blood brother to the placid, grass-consuming cow? But in this ancient New Mexican fauna this specialization and differentiation of habits was barely beginning. The carnivores of the time — called creodonts — were less carnivorous, and the herbivores—condylarths—less herbivorous. There were no exclusively meat-eating animals like the tiger and no grazing animals like the cow. (In fact there were no grassy meadows to graze on; the meadows came later and with them, with typically mammalian adaptability, evolved grazing from more primitive browsing animals.)

Thus the creodonts and condylarths all looked very much alike, differing only in size and proportions and in minor anatomical details clear only on careful study. They were almost all rather squat, heavy-limbed animals with five toes, each ending in what was neither exactly a sharp claw nor a blunt hoof but something between the two. Their heads had more or less the simple proportions of the head of a dog or a bear, although not as pointed; but the braincase was smaller because the brain itself was still very primitive in comparison with the brain of later mammals. Their tails were long and clumsy, slowly tapering from an unusually heavy base. These animals varied from about the size of a rat to that of a police dog—there were no really large mammals as yet. Many of the smaller forms lived mostly in the trees, while the larger ones ambled about in the forests and glades.

A few of the creodonts were already specialized to the degree that they preferred a diet of carrion and only resorted to other food under the sharp stimulus of hunger; but most of these animals, creodonts and condylarths alike, were more or less omnivorous. Probably all of them ate some carrion when they found it. The more active creodonts may occasionally have been able to kill a multituberculate or an unwary condylarth. They all doubtless relished berries, fruits, and nuts. Some of the larger condylarths probably also relied heavily on succulent leaves and shoots in their diets.

Primitive as they were, these relatively clumsy mammals were full of promise for the future. The creodonts exemplified a type of structure that was capable of progressive adaptation into all the diverse sorts of later carnivores, and the condylarths foreshadowed the even greater diversity of later herbivores.

The other conspicuous members of the fauna, the taeniodonts, held no such promise. They were already beginning to specialize in a peculiar way that did, indeed, continue and intensify for some millions of years—but eventually it proved fruitless when the stock died out without further descendants. They exemplify a sort of unsuccessful experiment in adaptation, an early, aberrant line of specialization. The smaller, more primitive taeniodonts differed little from the creodonts, but the more peculiar large forms, with nearly the size but not the form of a collie, were still more strange. They had snub noses, heavy, deep jowls, strong, gnawing canine teeth, and large, blunt cheek teeth. Their bodies were peculiarly heavy and clumsy and their strong limbs, terminating in large claws, seem to have been adapted to digging and tearing up roots.

More progressive animals do not appear in this first, archaic fauna of the Age of Mammals as revealed by the famous fossil field of New Mexico's San Juan Basin. But somewhere, still isolated and hidden, they were already beginning to arise. As the millennia passed, from time to time some of these burst the bounds of environmental and geographical isolation and spread over much of the world. Thus in a few million years the modern true carnivores were to spread and, after a long struggle, to oust the survivors of their ancestral group, the creodonts. The early four-toed horses and other ungulates were similarly destined to replace the condylarths. Most significant of all, and sooner than the incursion of more advanced carnivores and ungulates, was to be the appearance of the primates, tiny lemurs and tarsiers, first forerunners of the long line leading to Man.

Be sure to read the next installment of the story of animal life in NATURAL HISTORY *for March.*

The Story of a TREE

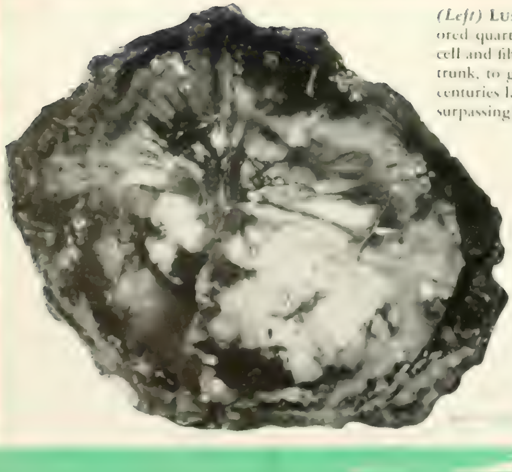
By H. E. Vokes

[illegible]

T[illegible] and on the scientific assumptions derived from that [illegible] the Petrified Forest of Arizona.

[illegible] up of the sucking swirls of transient whirlpools and the frightened bellowing of a crocodile-like phytosaur, who found even his strength inadequate to stem the mad current. The swollen waters, their hunger seemingly unsated by the load of sand they bore, tore ceaselessly at the bend in the bank where towered the tree of our story—a giant landmark in a strange, prehistoric world.

It was a tall, majestic, unusual tree. Like its nearest living relatives, the araucarian pines of South [illegible] lumpy bark and a bushy crown at the top of its tall trunk, with triangular leaves that were broad, short, and sharp-pointed. It was one of the early cone-bearing trees. Microscopic study of its woody tissues has [illegible] that the group in which it has been placed has been [illegible]



(Left) **Lustrous multicolored** quartz replaced every cell and fiber in the ancient trunk, to give us, countless centuries later, an object of surpassing beauty

A swift scientific journey through 150 million years of the earth's history tells the secrets of a forest that was immortal. —The events which gave America that extraordinary natural wonder, Petrified Forest National Monument

Many floods had torn at the bank by the great bend. Each had exacted its tribute of sand and soil; and now the undermined banks, faced with new demands, gave way. Slowly, reluctantly it seemed, the tree fell. A loud splash—a momentary note in the symphony—was followed by a new sound, as the waters hurled themselves against the inert trunk lying across the flood, held in place only by roots not yet torn loose.

Frantic with fear, the phytosaur strove vainly to battle the current which swept him into the great bend. With a crash he was driven against the fallen tree. Inert but not yet dead, the animal was sucked under the tree and hurled downstream, at times completely submerged, until he was soon drowned. A capricious current carried the body into the shallows, where it grounded. As the flood waters subsided, it was covered by sand.

More than 150 million years later a scientist found the remains. Today they are a museum treasure.

The tree rode out the flood and, as the water fell, its trunk remained a natural bridge over the stream. In the warm days that followed, its leaves dried up and the remaining roots died and became brittle.

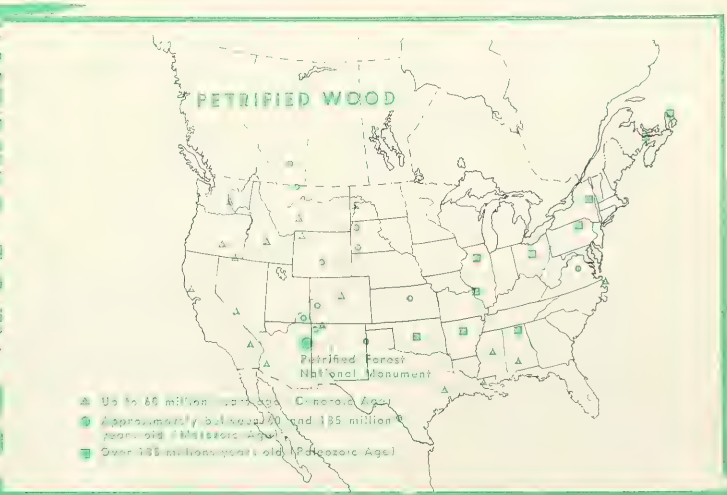
Floods were not uncommon in that country. Once again yellow waters roared down the valley. The roots snapped and the leaves were washed away. The great trunk rose again on the flood and, spinning and crashing into boulders, was borne down from the hills. The bark was stripped off, the wood torn and splintered.

One hundred miles downstream on a broad, low plain near sea level, it finally came to rest on a sand bar. We do not know how many floods aided in transporting it, but it was only a remnant of its former glory. Only the broad stump told of its former root system, and not a single branch remained.

Sand drifted around it. Distant volcanoes gave forth great clouds of volcanic ash which, carried by the winds, settled round about and buried the tree, choking streams and building up a new land surface. Across this new surface, rivers developed new courses, as more sand and more ash buried the log deeper. More trees died on the uplands and were swept down.

More than 150 million years passed. These were years when the giant dinosaur *Brontosaurus,* the "Thunder Lizard," shook the earth with his tread and passed from the scene. Fearsome *Tyranosaurus* tyrannized the descendants of *Brontosaurus* and was gone. The dinosaurs finally succumbed before the

THE PETRIFIED FOREST of Arizona is the best known to American tourists, but almost every state has its deposits of petrified wood


PETRIFIED WOOD
Petrified Forest National Monument
△ Up to 60 million years ago (Cenozoic Age)
○ Approximately between 60 and 185 million years old (Mesozoic Age)
□ Over 185 million years old (Paleozoic Age)

[illegible]

[illegible] particle by particle, by the silica. Finally there was nothing left of the original tree, but in place of its [illegible] nal cell structure.

Pure quartz is white or colorless. How, therefore, did these petrified trees acquire their brilliant reds and yellows? The circulating waters bore, in addition to their principal load of silica, traces of iron, manganese, and other minerals. The reds resulted from iron coloring, the yellows from manganese.

The Petrified Forest of Arizona might have remained hidden from human eyes had not a great movement of the earth's crust, perhaps a million years ago, lifted all the land of the Colorado Plateau, permitting the overlying material to be weathered away. The whole region was raised more than a mile above sea level, and the processes of erosion at once attacked the rocks, crumbling them so that the streams [illegible] of our tree again lay on the surface of the land, in a world whose life and appearance had entirely changed from the time when it had last been exposed.

That is the story of a tree in the Petrified Forest. It may seem a fanciful tale, but it is based on the evidence that anyone visiting the Forest can easily observe. All the trees lie prostrate. All are battered and bruised. Very few show any remnants of their bark, and branches and roots are rarely found attached to the trunks. [illegible] a tangled mass resembling a log jam. Only a few stumps have been found, and one of them was completely inverted, with its roots uppermost.

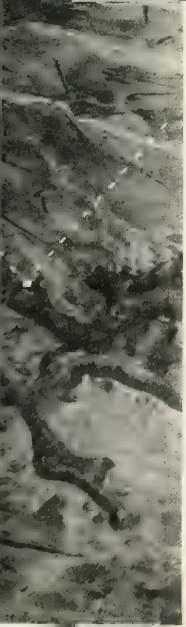
All are found in sandstones that bear every evidence of being deposited when material was washed out by flooded streams. Ripple marks, current bedding, sun cracks, and raindrop impressions tell this story, as do the shells of fresh-water clams and the bones of the crocodile-like phytosaurs found in the same rocks. Particularly significant are the well-preserved leaves of lowland, swamp-loving types of plants: ferns, scouring rushes, and primitive cycads. Only rare fragments of the leaves of the *Araucarioxylon* have been found.

The presence of distant volcanoes is shown by the widespread deposits of ash throughout all the Painted Desert region. In fact, most of the brightly colored, banded rock layers of this region were formed when beds of ash decomposed and were leached out by the circulating ground waters, which removed much of the silica from the rocks as previously explained.

In the mythology of the Piute Indians the petrified trees are held to be the broken weapons of the great Wolf God, and the several "forests" comprising the Petrified Forest area are said to mark the battlefields where he fought. To the Navahos the logs are the bones of Yeitso, a horrible monster who was here destroyed by the Sun God. But to the student of earth history, the Petrified Forest is not a battlefield. It is rather a burial ground, where the vanquished who had fallen in a great battle of Nature waged on the uplands some distance away, were given an honorable burial. Today they form their own monument.

Photos by R. T. Bird

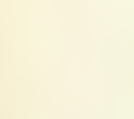
DRENCHED in the brilliant Arizona sunlight, the Petrified Forest is a scene of riotous colors. The minerals which the rocks gave the petrified trees did not rob the landscape of its rich hues. The Painted Desert, likewise a popular spectacle with motorists, is near by



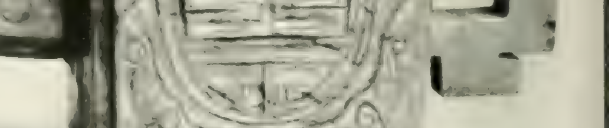
IN THE UNUSUAL AERIAL VIEW at left the sharp-eyed reader will be able to pick out many of the logs visible in the photograph above, which was taken from the point indicated by the square. At right, a closer view of some of the logs that give us a glimpse of the world 150 million years ago

Salutations and Inscriptior

(Left) LONG LIFE, a thought frequently represented in the decorative art of China, is here expressed in a simple pendant of white jade. The approximate position of this form in the evolutionary development of the symbol can be seen below — W[illegible] C[illegible]



THE ACTUAL CHARACTER for Long Life in Chinese *(at left)* evolved into many stylized variations as shown at right



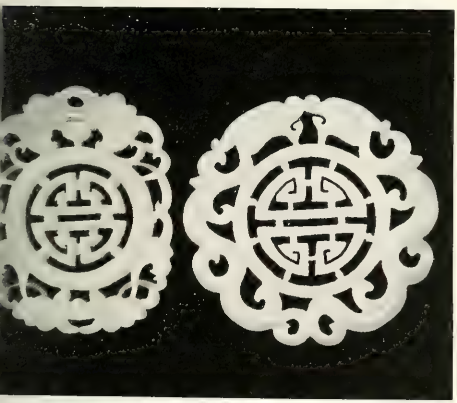
n JADE

By HERBERT P. WHITLOCK

Curator Emeritus, Research Associate in Jade,
The American Museum of Natural History

From ancient origins which the Occidental is surprised to recognize in the language itself, the meaningful designs wrought by the Chinese in jade have become one of the world's most richly endowed artistic forms

(Left) THIS BEAUTIFULLY proportioned receptacle was used as a wine pot in the Ming period (A. D. 1368-1644), Golden Age in the history of Chinese art. Like many examples of the virile and enduring art of China, this object is guarded over by the *shou* mark, symbol of long life—in this instance a rare variation of the design. (Drummond Collection)



(Above) TWO PENDANTS of the Ch'ing period carved from white jade, with circular variations of the *shou* mark. (Drummond Collection)

To trace the origin of the written language of China we must go back into the legendary past of this ancient people and follow the development not only of the written characters but also of their engraved equivalents.

The earliest type of these characters, like the hieroglyphics of Egypt, were pictograms, rough drawings of objects—a tree, a man, a bird, and so on. But, as Herrlee Glessner Creel points out,* although this earliest known Chinese writing contained many words that are obviously pictures, the writing itself is not picture writing, nor is it crude or primitive. The details of a system of writing may be altered so that the symbols are changed beyond recognition, but the system itself approaches perfection. Such an approach to perfection in Chinese had already been made by the writing system of the Shang period (B. C. 1766-1122).

Subsequent modification and combination of the Shang characters followed with the growth of the language. Whereas the "oracle bones" of the Shang dynasty were engraved with characters that numbered at most 2500, the Chinese of today use upward of 70,000 characters. This development, which began in the Chou period (B. C. 1122-249), includes in addition to the original pictograms at least three new sorts of characters: (1) Symbols expressing concepts without shape (Indicators). These represent such relations as *central, above, below,* etc. (2) Composite characters that express an idea. Thus the symbol for "brightness" is made by combining the pictograms for the sun and the moon. (3) Compound characters in which the more important element simply represents a spoken sound (Phonograms). The sound may express several meanings, and the specific meaning intended is determined by the pictogram used with it.

In the hands of such a people as the Chinese, whose sense of symmetry and balance is obvious in all of their art, the rude pictograms of their early writing became conventionalized into a calligraphy of graphic beauty, whose decorative possibilities can hardly be exaggerated.

Early in this process of evolution was developed the form of writing known as the "seal" characters,

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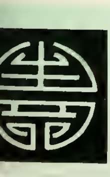
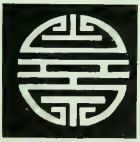
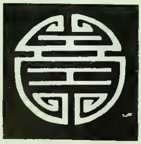
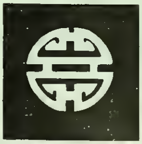
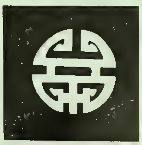
*See *The Birth of China*, p. 159

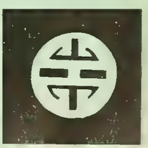




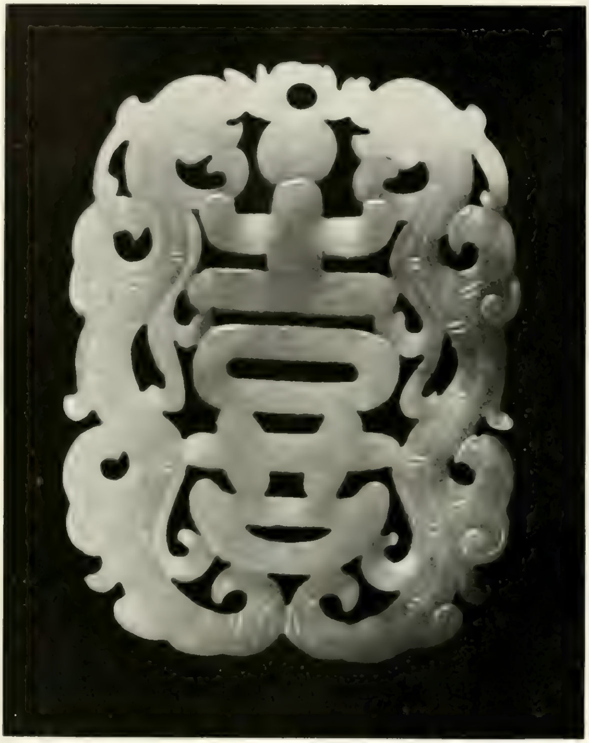








(*Below*) THE HAPPINESS character, supported by two dragons, is here carved in the form of a pendant of white jade. Ch'ing period. [illegible]

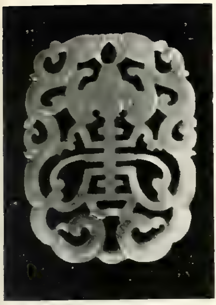


because they were used in inscribing seals, notably the famous Imperial Seal, made for the Emperor Ch'in Shih Huang in 246 B. C. As cut for inscriptions on jade seals, these characters were presented in relief and in reverse, so as to furnish a clear and legible imprint. They were also used for incised inscriptions on such jade pieces as the *kuei* (scepter of authority) of the Han Period.

Because of the fact that the beauty and balance in their design make them highly decorative, the seal characters have been extensively used by the modern Chinese carvers of jade for inscriptions, in much the same way as modern Occidentals use black letter or Gothic type to print ornamental notices or to engross diplomas or certificates. When seal characters are employed in this way they are almost invariably carved in relief.

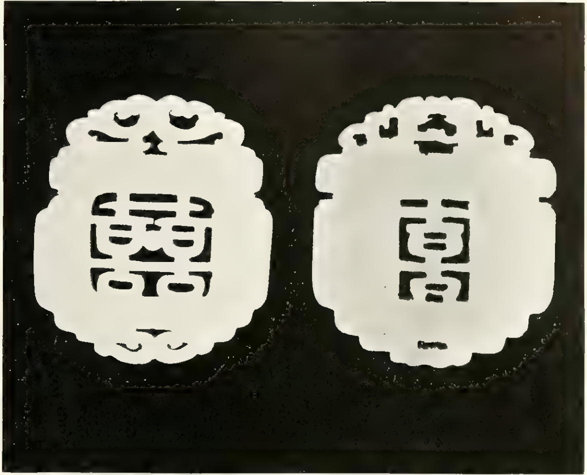
From ancient times the Chinese race has been characterized by a love of ceremonious formalities such as the presentation of gifts which express auspicious wishes. Several of the characters that signify such wishes, such as long life, happiness, wealth and felicity, have been carved in jade to form pendants to be attached to the girdle or worn on a knotted silk cord around the neck. These jade pieces, which are, of course, less perishable than the same characters painted or stamped on paper to be attached to doorways, are often highly ornate. The chosen character has been conventionalized almost beyond recognition.

The character expressing long life or longevity is especially popular and is said to have over 100 variations. Starting from the character as written to express long life, we are able to follow successive forms, each more conventionalized and balanced than that from which it was derived, until we come to the cir

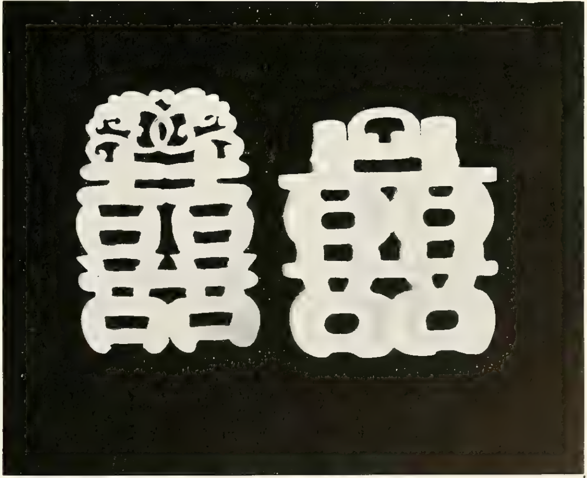


(Left) A BAT hovers above the symbol for Happiness in this Ch'ing period pendant. Dragons again form the frame. (Whitlock Collection)

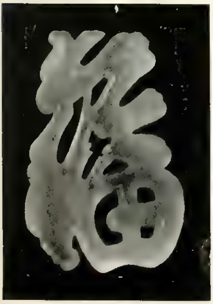
(Right) DOUBLE HAPPINESS is symbolized in the left-hand pendant by duplication of the sign used singly in the piece beside it. Ch'ing period. (Whitlock Collection)



(At right) DOUBLE HAPPINESS is expressed simply, without the usual ornate border. Ch'ing period. (Whitlock Collection)



THE SMOOTH lustrous texture of white jade gives unusual beauty to the symbol for Good Luck as carved below in a pendant of the Ch'ing period. (Whitlock Collection)



THE SIGNATURE of the Emperor Ch'ien Lung appears at lower left in the tablet below. At right are shown both sides of another similar tablet engraved with the Emperor's odes, which are translated opposite. [illegible]

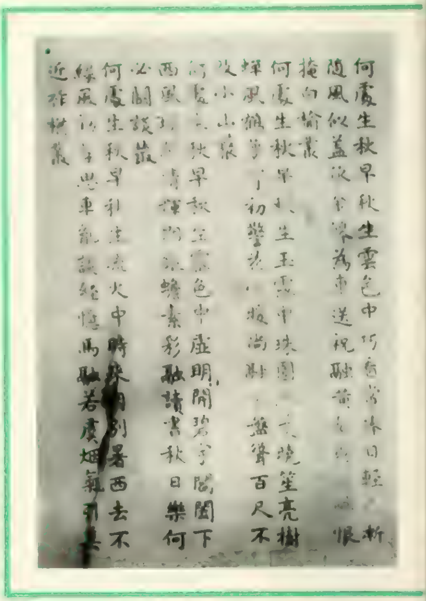
[illegible] Some of the elements in the evolution are figured in the drawings on pages 108 and 109, which represent the [illegible] symbols as studied from actual jades. Sometimes the circular version of this shou mark is used as the center of such a design as "The Five Happinesses," or it is made the rallying point of other auspicious symbols.

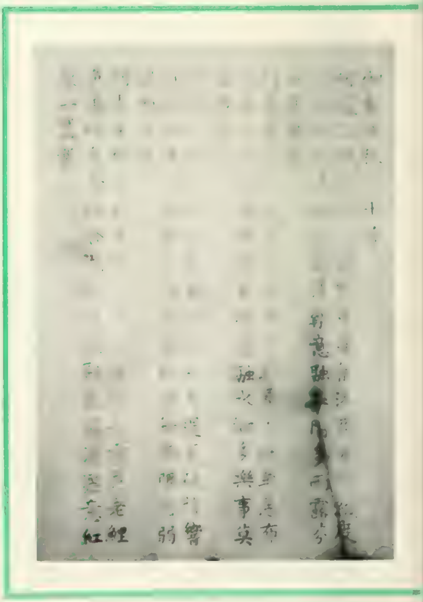
The character signifying happiness is almost as universally used as the *shou* mark, but since, unlike the latter, it has no circular variant it is not so adaptable to a symmetrical balanced design. In fact jade pieces carved with this character are seldom otherwise decorated. The happiness character is, however, frequently doubled by uniting two single characters placed side by side. The resulting design is known as "Double Happiness," and is frequently given as a wedding present or as an accompaniment of a present made to a bride.

The character that means good luck, although often carved as a plain pendant in jade, is also sometimes made the center of a design composed of bats, butterflies, and many other auspicious symbols. It is also much used in its seal character variant in the combination known as *ta chi* or "great good luck." The *ta chi* in raised characters is often to be found either on tablet pendants or on conventionalized representations of gourds.

Other characters in frequent use are those that express Wealth, Riches, Eternal Prosperity, Virtue, Honor, Rank, and Congratulations.

[illegible] both script and seal characters are to be found in the various inscriptions on jade pieces carved to perpetuate the best Chinese poems known as odes. A very noted example of this characteristic writing is contained in the odes composed by the Emperor Ch'ien Lung and engraved on jade tablets by one of his court officials. Two of these tablets are among the treasures of the late [illegible] Drummond. One of them, depicted at the head of this column, bears the signature of the Emperor Ch'ien Lung in the lower left-hand corner. The other, engraved on both sides with odes, is illustrated at right, with a translation for which I am indebted to Mr. Yu Ming Chung.





Odes to the Coming of Autumn

By His Imperial Highness, CH'IEN LUNG

Where does Autumn come early?
It comes in the heart of the Imperial Palace.
At night lotus leaves begin to curl,
With a pearl garment to resist the cold wind.
It is pleasant to attend to state affairs in blue clothes;
It is pleasant to observe agriculture.
The jade staircase is covered with rain and dew,
While fragrance comes from the orchid trees.

Where does Autumn come early?
It comes in the heart of the road along the river
Where sacrifice is being offered at the altar of Earth,
Not for the spread of wind to push the sail,
But for a soft breeze that envelops hills and towns.
The fisherman's garment is gay in the twilight,
Where pleasant events abound in the village;
So do not pass the mulberry bushes in haste.

Where does Autumn come early?
It comes in the heart of a rustic village,
Where water baskets have leisurely spent the summer,
And the sound of the pounding of grain echoed in the wind.
The road is long and a letter hard to reach;
The right is deep but dreams never sound
To understand the boundless thoughts.
Just look at the brows of the weak lady.

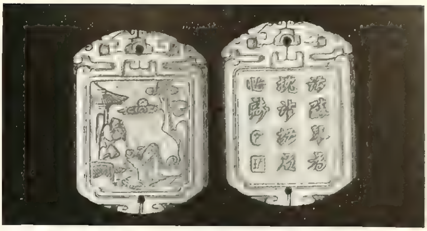
Where does Autumn come early?
It comes in the heart of a broken river bank.
The willows are scattering cotton like snow;
The flowers are fading and the wind rising;
The twilight dissolves into the dark vapor
Which reflects peacefully on the lake.
It is most pitiful to experience the sad feeling
With the appearance of the red bushes of smart weeds.

Where does Autumn come early?
It comes in the heart of a piece of colorful cloud
Which looks artfully as if always holding the sun
And sailing lightly and slowly with the wind,
Like a roof filled with golden radiance,
Like a chariot carrying the Sun God.
The yellow ant is grazing on the river bank
And sadly hiding herself among the white elms.

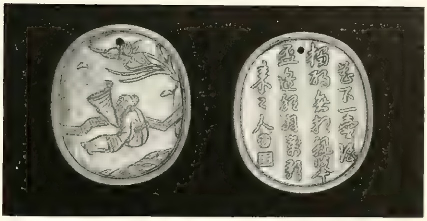
Where does Autumn come early?
It comes in the heart of a drop of dew-like jade,
A pearl that brings morning to the pond weed on the pond.
Clear as a pipe, a cicada is singing on the treetop,
While a crane is still dreaming at dawn,
Warm and tender still is the flower's heart.
The golden foliage towers a hundred feet high
But has no rivalry to the bushes on the little hill.

Where does the Autumn come early?
It comes in the heart of a twilight
Which spreads faintly yet clearly over the sky.
The autumn is over-powering the western breeze,
Bringing purity, radiance, and brightness to the tiny door,
While silver rays lend colors to the rising vapors.
It is pleasant to read in an autumn day;
Why should we waste our time in idle talks?

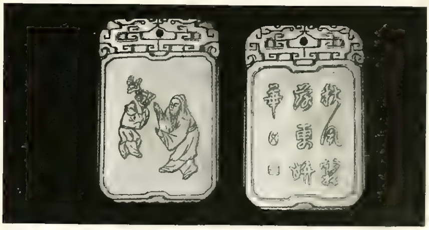
Where does Autumn come early?
It comes in the heart of a flowing fire,
Which often flames with the departing summer
And moves westward without the wind.
Hard studying reminds one of Chê Yin;
Classic discussions recall Ma Yung.
If the temptation of the misty vapor is irresistible;
Do not approach the trees of hawthorn.



THE INSCRIPTION above, translated by Mr. Yu Ming Chung, reads: "When autumn wind blows and the frost falls, [the landscape] becomes more beautiful."

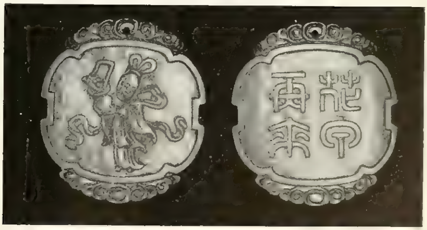


RAISED CHARACTERS are typical of the small tablet pendants shown here and on the following page. The tablet above reads: "I make my lute my pillow, tending the stones which can speak."

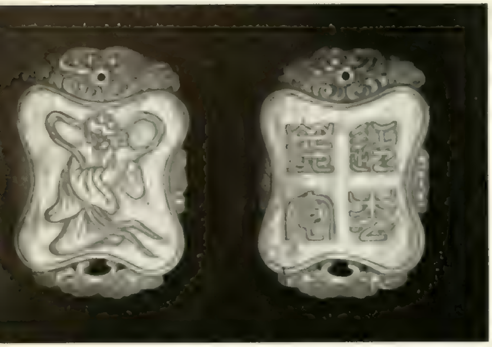


(Above) "WITH a pot of wine, under some blossom tree, I drink alone with no relatives around, holding up the cup to invite the bright moon. Let no one come to disturb my peace."

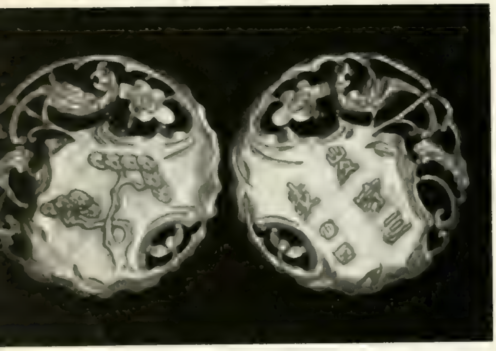
Below at left is depicted the immortal street singer of China, Lan Ts'ai-ho bearing aloft her basket of flowers. The obverse side bears the appropriate inscription: "Flowering trees return again."



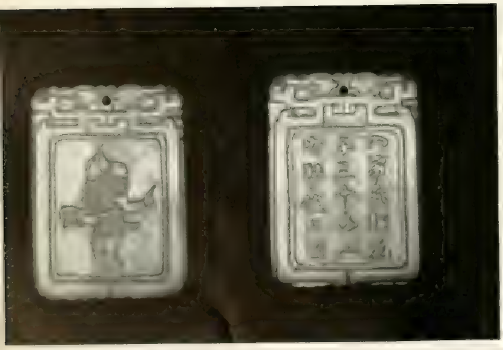
THE JASPER PENDANT below, engraved with a lotus motif of low jade, carries the inscription "Peace engenders long life."



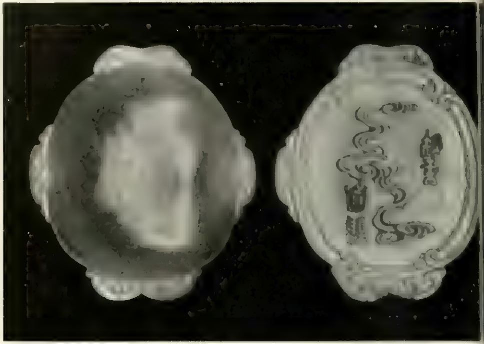
THE INSCRIPTION below, "Three Companions of the cold season (winter)," refers to Buddha (indicated by bamboo), Confucius (the pine), and Lao Tzu (the prunus blossom)



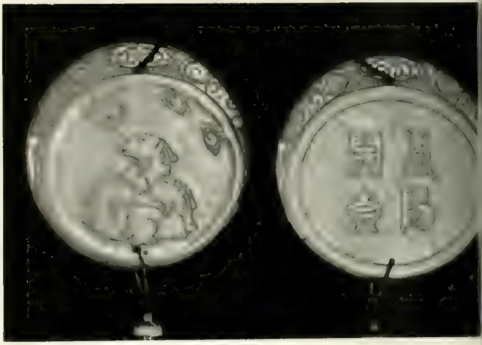
(Below) "I LEAD A BAND of thirty hunters to hunt the forest for flesh-eating tigers."



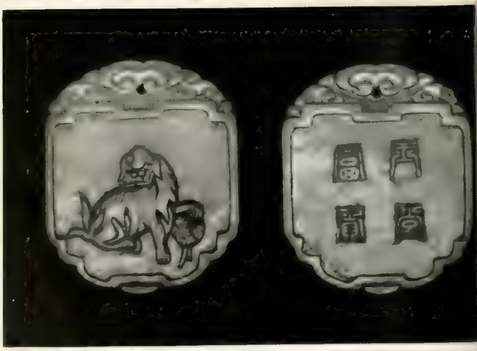
THE TABLET below is in the form of a beautifully wrought hand rest, which allows the hand to glide smoothly along when writing. The inscription on the underside reads: "Dragons and phoenixes are auspicious creatures."



THREE SHEEP *(below)* which enabled a famous warrior to escape from prison gave rise to the accompanying inscription: "Propitious sheep open the universe."



(Below) A FU LION counterbalances the inscription, "Riches and honor in the jade hall." Thus in many artistic forms, Chinese artists express their ancient philosophy



GIANT FISHES OF NORTH AMERICA

Titans such as the average angler envisions only in the most golden of his dreams come to light when we examine the records of the Oregon sturgeon and the alligator gar

By E. W. GUDGER

Honorary Associate in Ichthyology,
The American Museum of Natural History

THE question perhaps most frequently asked of us in the Department of Fishes in the American Museum is, "What is the biggest fish?" To this my stock answer has been, "The whale shark is the largest fish in the world." But occasionally the query comes, "What is our biggest fresh-water fish?"

The question cannot be answered offhand. For years I have had it in mind to dig up the evidence and answer it. But the task is large. The information is widely scattered, thoroughly hidden in technical works or in books of travel, and hence is to be gathered only with much work (digging is a good word), and good illustrations are almost nonexistent. Then unfortunately most writers content themselves with saying, "Grows to large size." Or they merely state, "Said to reach a length of twelve to fourteen feet"—without giving the authority. Every effort has been made to verify the sizes and weights given herein.

The question of what are the largest fishes will have to have several answers since there are many more than one candidate for the distinction. To set forth the sizes of these great fishes will call for all the big fish stories that I know, and the reader had better get into his "dugout" and stay there until the big-caliber fish-story barrage is over. And like "Old Bill" in World War I, if the reader gets tired and knows of a "better 'ole," let him "go to it."

But before I begin my big-fish tales, let me pray the prayer of the ardent fisherman of today as well as of him who wrote it hundreds of years ago:

> "Lorde, on a somere's Daye,
> Wyth an Hook and Angell,
> On Grassie Swarde I laye,
> And inn plashyngge Waters dangell.
>
> "Lord, suffer me to catch a Fyshe
> So large that even I,
> When talkyngge of it afterrwardes
> May have no neede to lye."
>
> *Angler's Prayer*

The term "big fish" is a relative one—as in the case of the one that got away,—relative to the fisherman's excitement and the listener's credulity. But there are in North America two unquestionable giants of the piscine world, the White or Oregon Sturgeon of the rivers of the Pacific Northwest and the Alligator Gar of the Mississippi and the other rivers flowing into the Gulf of Mexico. Interestingly enough these fishes are both members of one of the "first families" of fishes—the Ganoidei. The ganoids (from the Greek word *ganoin,* meaning shining) have large heavy scales with an outer layer of shining enamel or ganoin. They are at least partially clad in armor as the photographs will show.

The White or Oregon Sturgeon

Found in the Columbia and Fraser Rivers of our northwest Pacific drainage, the white or Oregon sturgeon is the largest of our American sturgeons and the largest of North American fresh-water fishes for which there are definite records. This giant bears the scientific name *Acipenser transmontanus. Acipenser* was the Greek name of a fish much esteemed by the ancients—perhaps a sturgeon—while *transmontanus* means across the mountains (the Rockies)—that is, western.

Of the Oregon sturgeon, Jordan, Evermann, and Clark say in their *Check List of the Fishes. . . . of North and Middle America* that it is, "Largest of the [American] sturgeons, reaching a weight of 1000 pounds. A record specimen taken at Astoria [at the mouth of the Columbia River, in Oregon] weighed 1900 pounds." Then they add, "Once abundant, now nearly extinct." And it may be said further that they are doomed to sure and swift extinction in the Columbia River with the building of the great Bonneville hydroelectric dam across the river.

I have sought in vain to verify this 1900-pound weight. Clark, the only surviving author, can give no authority for it, nor can any of my correspondents in Seattle and the Columbia River country. However, as a result of this correspondence, some most inter-

[illegible]

[illegible] the side.

[illegible] longer but lighter sturgeon taken in the same locality [illegible] pounds of roe, which were made into caviar.

In the next photograph is seen Mr. L. J. Farley, [illegible] sturgeon. This was taken at the mouth of the Yakima River, [illegible] Columbia, at the point where, after flowing south, the Columbia turns [illegible] on a setline hook baited with lamprey eel—a rather unusual bait one would think for a sturgeon. Mr. Farley writes that he has heard of a 12-foot white sturgeon weighing 1100 pounds taken from the Yakima River some years earlier. Of this he unfortunately has no photograph.

Mr. A. B. Chapman, of Seattle, Washington, sent me a photograph of a huge white sturgeon lying on the ground. This photograph was, I regret to say, not suitable for reproduction. The fish was taken from the Columbia River at Kalama, Washington, near where this great river turns west to run into the Pacific Ocean. It was a female 11 feet 6 inches in total length. It was the same size as the preceding fish but slightly heavier—835 pounds. The roe weighed 90 pounds and was sold for $90. The total return of this fish to the fisherman was about $150.

The information on the next and largest Oregon sturgeon on record was sent to me by Dr. Wilbert M. Chapman of the Fisheries Laboratory of the University of Washington, Seattle. He had the facts from his father, Mr. A. B. Chapman. This great fish was captured in the Columbia River at Vancouver, Washington. It was taken in May or early June, 1912, rolled up in a salmon net after the fashion of [illegible] weighing 1285 pounds, of which the eggs accounted for 125 pounds. And, curious to note, the weight of the head was also 125 pounds. Mr. Chapman saw, measured, and weighed this fish. He had it photographed, but the photograph, most unfortunately, got lost. Mr. Chapman affirmed that this was the largest sturgeon taken in the lower Columbia during all the years when big fellows were being caught.

This 12½-foot, 1285-pound sturgeon is the largest Columbia River and Pacific Northwest fish of which there is definite record. It is a grievous loss that the photograph of this colossus among American sturgeons is not available.

However, huge as is this 12½-foot 1285-pound fish, there is a legend of one still larger. This legen[illegible] been preserved, mounted, and exhibited at the Chicago World's Fair in 1893. Diligent inquiries have brought no definite information; the huge fish seems to have vanished into thin air. Probably it is the one referred to by Jordan, Evermann, and Clark.

Doctor Chapman writes me that the days of these giants in the lower Columbia are over and gone, that even as late as 1934 one had to go far up the river to the region of the mouth of the Snake River to catch one as heavy as 500 pounds. This particular sturgeon goes far up in fresh water to breed, but seems to spend much of its life in salt water and there attains its growth. But with Bonneville Dam lying athwart the Columbia, with its salmon-sized fish ladders blocking the ascent of these large breeding fish, and with intensive fishing in the lower river, the day of the great Oregon sturgeon is over. How are the mighty fallen!

Huge as are these sturgeons, and as much food as they require to keep their great engines going, they are not predators. The round suctorial mouth devoid of teeth forbids this appellation. This mouth is under the head and is a protrusible spout-like structure. With it, the sturgeon gathers in small fishes, crawfishes, and smaller crustaceans, insect larvae, mollusks, and other dwellers on and in the muddy bottom. But when one considers the great size of this West Coast sturgeon, one wonders how it can get all the food of this kind that it needs to grow so large and to navigate when grown.

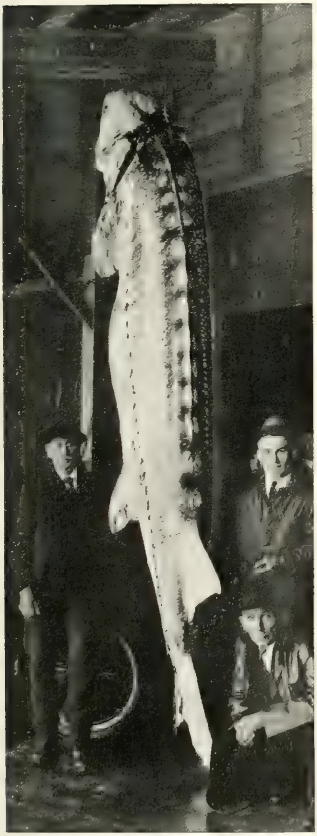
This sturgeon is a fish of very considerable economic importance in the Northwest. Its flesh is eaten, and from the huge ovaries of the female the thousands of eggs are taken and converted into caviar. The air bladders are made into isinglass. The extinction of this great fish will be a very considerable economic loss to the people of the Columbia and Fraser Rivers and of the adjacent country. The same is true of an eastern sturgeon once abundant in the Delaware and Hudson Rivers. Along the Hudson, its flesh was formerly in great demand under the name "Albany beef." Through overfishing, this eastern sturgeon is now practically extinct.

The Alligator Gar

The alligator gar, formidable ganoid of the central basin of the United States, is, as the reader will presently see for himself, the most interesting fresh-water fish of our country. It is the unchallenged ruler of the Mississippi River and its tributaries and of the other rivers flowing into the Gulf of Mexico. It is clothed with a coat of mail made up of imbricating or overlapping scales composed of an inner layer of bone and an outer one of shining enamel or ganoin. The scientific name of this armor-clad medieval knight is *Lepisosteus spatula*, a composite name denoting its bony scales and spade-shaped snout. The appropriateness of this title for this great fish is evident from a study of its photograph.

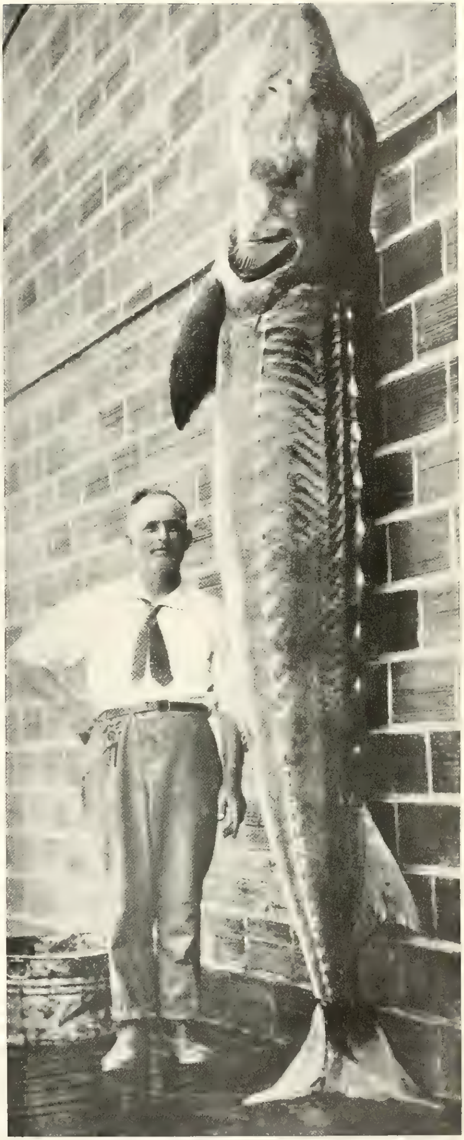
As to the accuracy of the appellation "alligator," I can give the following personal experience. Forty-three years ago, on the Bryson Place, ten miles below Little Rock, Arkansas, I walked around a point of land on an old oxbow "cutoff" or bayou of the Arkansas River and came in view of a 6-foot gar of this species lying on the shore head on to me. Recoiling, I ejaculated to my companion, "Look, an alligator!" The illusion was perfect. Earlier in the day, it had been taken in a seine by fishermen, killed, and left on the shore. I know of no fish with a name so aptly given. Its heavily scaled body and broad, short, blunt (spade-shaped) snout surely produce the illusion noted in my case.

The alligator gar is the largest fish found in the great central valley of the United States. Years ago I began the preparation of an extensive treatise on the natural history of this armored giant. However,



Courtesy of Dr. L. P. Schultz

(Above) Two FEET and 270 pounds short of the record: a gigantic Oregon sturgeon from the Fraser River. This fish tipped the beam at 1015 pounds and measured ten and one-half feet



Keystone View Company

CLOSER to the camera, this colossal sturgeon caught by Mr. L. J. Farley seems to dwarf the one at left. It is a foot longer but 189 pounds lighter. The Oregon sturgeon is doomed in the Columbia River by the erection of the Bonneville Dam [illegible] From that point I extract the following [illegible] [illegible] an alligator five feet long and succeed in devouring him, after cutting him in two with its powerful jaws. [Perhaps another reason for naming it alligator gar] . . . These jaws are from 12 to 18 inches long."

[illegible] says that his fish reaches a length of 20 feet or more. Others, more or less from hearsay (either by word of mouth or in written communication) say that the alligator gar attains a length of 12 to 14 feet today,—but I doubt it. As the late Doctor F. A. Lucas used to say, "All fishes shrink under the tape measure." Still it is possible that in lower Arkansas, Mississippi, and [illegible] monsters may have lived in earlier days. But prolonged fishing and hunting (for this big gar has been literally hunted with bow and arrow, with shotgun and rifle) have killed off the big fellows.

From Arkansas, I have the following authentic records. The late Louis Reitzammer, my most valuable correspondent, at Arkansas City on the Mississippi River, sent me these: (1) 7 feet 4 inches long, 43 inches in girth, 154 pounds on the scales; (2) 7 feet 5 inches long, 49 inches in girth,* 163 pounds weight; (3) 7 feet 11 inches long, 52 inches in girth, 181 pounds weight. [illegible] You need not be surprised at accounts of 10-footers. I am satisfied that we have them here that large, but we have not been successful in landing them."

The next fish were taken but two miles away from where I saw my "alligator" and in the same system of "cutoffs" from the Arkansas River. My former student, the late Dr. Henry Thibault, caught two big fellows near his home. Here are his figures: (1) 7 feet 8 inches long, 178 pounds in weight; (2) 9 feet 2 inches long, 232 pounds in weight. This latter is [illegible] get an authentic record. It can be relied on, for the man who made it was one of the most meticulous persons I ever knew. He wrote me that the head alone [illegible] friend J. R. Alexander measured a head that was [illegible]

[illegible] who knows the natural history of Louisiana animals [illegible] unverified accounts of huge specimens taken in those [illegible] long and to several hundred pounds in weight." An [illegible] and weighs over 200 pounds." A third correspondent speaks of the catching of specimens 8 to 10 feet long, and of the killing of a 200-pound fish. Another account is of a 7-foot 8-inch specimen weighing 321 pounds—a weight entirely too great for the length. [illegible] worth. Both Viosca and I think that these men caught unusually large gars, but we doubt if all of them actually measured and weighed their fish.

Dr. C. H. Townsend (formerly Director of the New York [illegible] Parish, western Louisiana, to study the alligator gar. While there he was the guest of Mr. Henry D. Whiton, of New York City, who had extensive business interests there. He went there several times a year and knew everybody in the parish. Mr. Whiton was very much interested in these large fishes. Doctor Townsend reported as follows: "Mr. Whiton furnished a record of a 12-foot specimen killed in Lake Calcasieu and measured by M'sieu Tata Ibert. He [Mr. Whiton] saw the broken remains of the fish and says that it was so much larger than any of the 8-foot gars known to him, that he accepted M'sieu Ibert's statements."

If Doctor Townsend had only seen and measured this giant (for giant it surely was) or had gotten and measured the lower jawbone, we would have an authentic record. From examination of a number of specimens, I have found that the lower jawbone, measured in a straight line from the front center of the jaw to the angle at the rear, closely equals about one-ninth the total length of the fish.

Viosca thinks that about 9 feet is the maximum size for those in the bayous of his state today. Mr. E. A. McIlhenny, of Avery Island, Louisiana, who has had long and intimate knowledge of our great fish, writes that in the great drought of 1925, he visited an inland lake that had gone nearly dry. He [illegible] ure over 7 feet, but the largest was only 7 feet 7 inches. The largest he has ever seen was taken in Belle Island Lake, Vermilion Parish. This female, which was full of eggs, measured 9 feet 8½ inches in total length and weighed 302 pounds. This and Doctor Thibault's 9-foot 2-inch, 232-pound specimen are the largest alligator gars of which I have found

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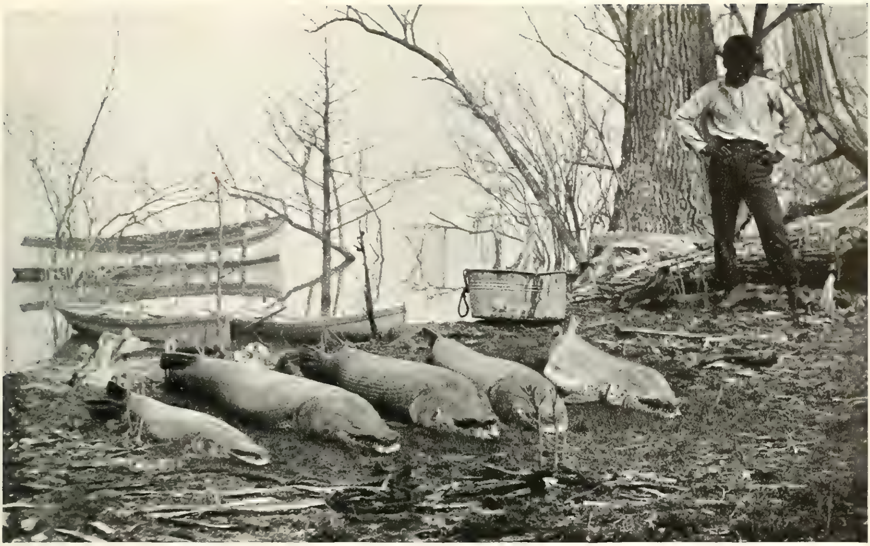
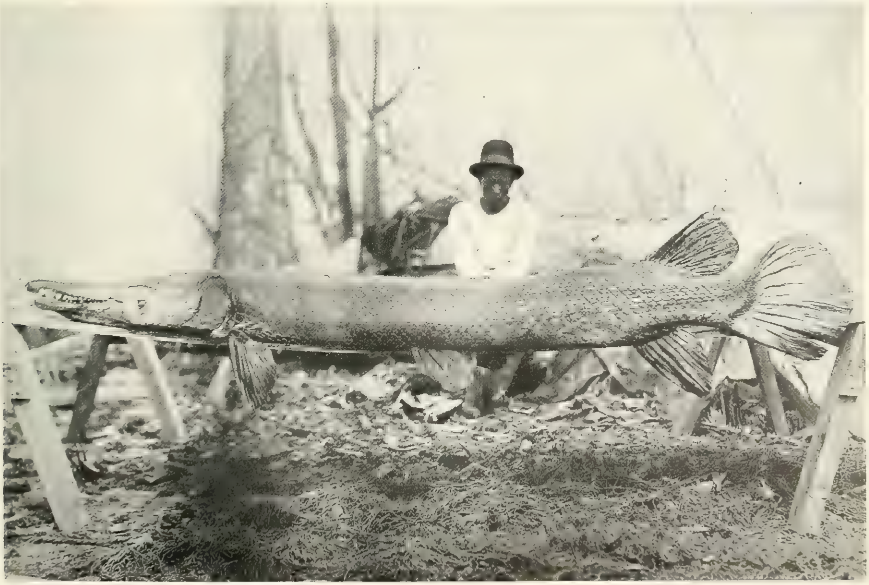


THE LARGEST FISH in the Mississippi Basin, the alligator gar, receives its name from its head-on resemblance to a 'gator. Unlike the sturgeon, the gar makes poor food. The eggs are not only useless as caviar but actually poisonous. These specimens were caught in Moon Lake, Mississippi, in 1910. The lanky gar below may not have fed in some time. Gars have dreadfully large mouths and sharp teeth and are voracious eaters. The record length is 9 feet 8½ inches, the record weight 302 pounds, though unofficial measurements exceed these figures

Photographs by Dwight Franklin



authentic records. These are reliable and may be [illegible]

[illegible] the mouth and the size of the dental apparatus. This [illegible] with such huge canine teeth. Manipulations indicate that the vertical gape quite equals the length of the jaws. Our fish is plainly a predator. Its requirements [illegible] it swallows its prey whole or at any rate in large fragments. Rafinesque says that one of them caught a young alligator and bit it in two, and swallowed the fragments. Others have alleged that it fights, conquers, and eats alligators. Hussakof in 1914 dissected a 6-foot 6-inch specimen and found in it a long-nosed gar pike, 2 feet 2 inches long, which the cannibal had engulfed head foremost. But the favorite food of *L. spatula* is the more digestible common fishes. Mr. Reitzammer's 163-pound specimen previously mentioned had in its stomach about 40 pounds of food-[illegible] buffalo fish, and a catfish.

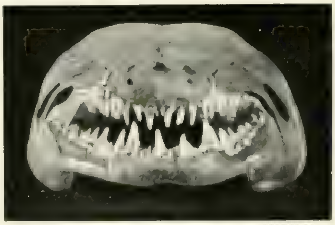
But here follows the prize account of the enormous voracity and capacity of the alligator gar. Below you [illegible] Progresso, Texas, which allegedly weighed "more than 300 pounds." It had a huge and protuberant abdomen, and when dissected, the cause for this aldermanic [illegible] 52 pounds of various kinds of fishes. These were intact and the [illegible] 52 pounds. The alligator gar is known also to catch and eat swimming ducks, and other small swimming animals.

Does it attack humans?

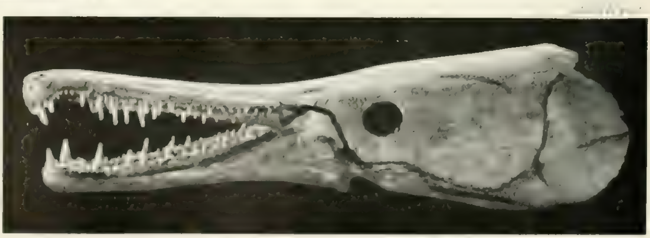
When one looks at the gaping mouth and huge canine teeth of our great fish, one is almost sure to ask, "Does the alligator gar attack man?" Now this mail-clad monster is not only an omnivorous predator, but scavenger as well. And the answer is that his scavenging propensities lead up to a habit that surely indicates such attacks. Throughout the territory in which our giant is found, fish docks are a part of the watery landscape. These are often mere rafts of logs spiked to stringers with a rough flooring [illegible] taining live fishes. From these the customer picks out his fish, the dealer cuts off its head and tail, scales and cleans it, and turns the prepared fish over to the customer ready for the pan. The rejectamenta are thrown overboard.

Here also, in an aquatic region having little good

(Left) THIS ALDERMANIC alligator gar, which was captured at Progresso, Texas, had eaten 52 pounds of fish



(Above) HEAD-ON VIEW of a huge gar. A human hand or foot caught between these sharp canine teeth could hardly be extracted



(Right) THE ALLIGATOR GAR has more and sharper teeth than an alligator. These jaws have been known to close on a hand carelessly put in the water off the docks where fish are cleaned. But alligator gars probably do not attack swimmers as often as reports would indicate

water (cistern water is largely restricted for drinking and cooking) most culinary operations—the preparation of fishes, birds, and squirrels for the pot, and the washing of kitchen utensils—are carried on at these docks or rafts. I have many authentic reports that semitame scavenging alligator gars collect around these docks to eat the offal thrown overboard. Then the inevitable happens, as is attested by numerous accounts from persons in widely scattered localities. Persons with blood and fish slime and fish fragments on their hands dip their hands overboard to wash them, and the gars seize these. One can readily believe that a hand caught between the teeth shown in the adjacent photograph could not be pulled back by the owner without its being badly mutilated, at least. Indeed a large fish with a good hold could easily pull a person overboard—as has happened.

But the reader queries, "Do these huge gars actually attack swimmers?" In answer, the newspapers of the lower Mississippi Valley contain many such accounts. All my attempts to verify these have resulted in failures. The late Doctor Thibault of Scott, Arkansas, wrote me of his total unbelief in such attacks. Once in swimming, he and a big gar bumped into each other. The reaction was mutual—without delay, man and gar each left the scene in opposite directions. "Before I could turn over and start for the shore, I could see the wake of the gar progressing 100 yards up the lake."

Doctor Thibault has had two cases of alleged attacks by gars referred to him for medical attention. One was a boy with deep lacerations on the abdomen. Careful examination revealed the presence of fragments of rotten wood. The boy in diving had struck the end of a sunken and rotten log. The other was a fourteen-year-old girl, with hands, feet, legs, and arms badly scratched in parallel bands. She stated that she had been attacked and nearly drowned, but had freed herself after a desperate struggle. Examination of the site of the alleged attack revealed an abandoned mass of old barbed wire—to which clung some fragments of the girl's red bathing suit.

Percy Viosca and Doctor Thibault both wrote that they have gone swimming in waters inhabited by hundreds of these big fish, without being attacked. Moreover, Viosca has seen men swimming in waters having both fish offal and gars in abundance—and there were no attacks. Perhaps these fish were well fed and possibly wild—that is, more or less afraid of men. While those hanging around fish docks are generally semidomesticated—not afraid of man.

The late Louis Reitzammer was through many years a very careful student of the habits and behavior of the alligator gar. The information sent me over those years checks absolutely with that from a dozen men over the lower Mississippi Valley and the Gulf Coast west to the Rio Grande. Early in our correspondence I had expressed my doubts about attacks on men and urged him to go carefully and skeptically into the matter.

This he did and finally, about two years before his untimely death, he wrote me of a man who dived from a fish dock and had the heel of his shoe torn off —presumably by a gar. Of an attack in June, 1926, on another man, he had personal knowledge and he sent me the duly-attested affidavit of Mr. J. S. Bowles. More than once Mr. Bowles had been hurt when diving—whether by accident or by a gar, he could not say. But this time he felt the fish between his arm and body and was badly cut—two gashes of about 3 and 6 inches long respectively. Mr. Reitzammer was a witness of this attack. "I did not see the fish with its mouth open, but a second after Mr. Bowles screamed, I saw not its entire body but its tail." A hook was baited, and shortly a 5-foot gar was caught. It was possibly the one that made the attack.

* * *

Here is the evidence, pro and con, which I have been able to collect. The alligator gar is an omnivorous carnivore—feeding on animal matter, dead or alive. A heavy, logy fish, a poor swimmer and hence a poor fish-catcher, he is probably hungry most of the time. When hungry, he will undoubtedly grasp a hand or a foot dipped in the water near him. That he will deliberately stalk and attack a human being, as a tiger does, I do not believe. But if a diver comes near a ravenously hungry fish or if the fish is scared or tormented, I can believe that an attack may follow. Personally, I would not care to be placed in the predicament.

Such are some of the facts gathered with much expenditure of time and labor. The habits of the alligator gar need to be studied at first hand by a skeptical scientific observer in the lower Mississippi basin where there are great numbers of this predaceous fish, and over a period of time long enough to get accurate and comparative observations.

The flesh of this great ganoid, unlike that of its large Columbia River cousin, is coarse and rank. It is rarely eaten throughout the lower Mississippi Valley save by the poorest Negroes, and by them generally only in case of necessity. The eggs measure approximately one-eighth of an inch in diameter, and not only are they not made into caviar (as are those of the sturgeons), but they are poisonous when eaten.

[illegible] widely with changing conditions and [illegible] thin your light bulb filament is before saving burned-out bulbs for their scrap value!

The American tungsten ore prospects are fairly good, because an interesting physical phenomenon, which [illegible] practical value. That is the property [illegible] degree by scheelite, or calcium tungstate,—the principal American ore. [illegible] or cathode rays. When ultraviolet rays are thrown on scheelite they are translated in some manner still unknown into visible light and the mineral fluoresces blue. Indeed, to [illegible] ment and shine it on the rocks. Small traces of this tungsten ore will glow brightly in this light, while most else [illegible] to find the deposits?

Considerable success has been met with in such ore surveys, and many [illegible] have been [illegible]. Many other uses have been made of fluorescence, but none more valuable than this. Amateur mineralogists, with their seem[illegible] have rendered a great service in the perfection of portable equipment, and no doubt they have discovered and will discover many new tungsten ore sites. So thanks to them, to the bountifulness of Nature, and to the satisfactory substitutes worked out by scientists, we need not look at our tungsten future with the misgivings engendered by some of our other metal wants.

YOUNG LIONS MUST LEARN

By John Eric Hill

Drawn by

G. Frederick Mason

THE mammals that live by hunting learn more and are less dependent directly on inherited patterns of behavior than the grass-eating kinds, and in the ability to learn, the lion must be nearly or quite the equal of the dog.

The cub is born with a deep-seated hunting instinct. One youngster will stalk and pounce on another or on the twitching tail of the mother, with the same eagerness and thrill exhibited by a kitten. During the year and a half of cubhood this play develops into a hunting and killing technique. Skill comes through long practice, imitation of the old lions, and obedience to warning growls of the mother. Most of their prey consists of large and strong animals, well equipped for self-defense, and its first attempts to kill are made under the watchful care of the mother-lioness. An untrained lion kills by clumsy mauling.

In certain parts of Africa lions commonly prey on the powerful Cape buffalo, while in other areas where this animal exists they leave it alone. Probably the lions that have been brought up by buffalo-killers learn how and carry on the tradition. A failure with such game is generally fatal to the lion.

One reason that most men killed by lions are mauled and die of blood poisoning or shock, rather than suddenly from the lion's customarily efficient attack, is that man-killing is not a common subject in the training of lions. When once they learn how, they can be quite successful, as was shown by the two lions of Tsavo that killed more than 30 men before their careers were ended by Colonel Patterson.

YOUR NEW BOOKS

**ALASKAN TRIP ● POLYNESIAN ASTRONOMY ● SNAKE MANUAL
STORM ● TAME GORILLA ● YANKEE STARGAZER ● MILKY WAY
ARCHAEOLOGY OF OUR SOUTHWEST ● WIZARD OF PHYSICS**

TOTO AND I: A Gorilla in the Family

- - - - - - - - - by A. Maria Hoyt

Lippincott, $2.50

THE Introduction, by Roger Conant, to Mrs. Hoyt's book is not only an introduction to Toto and gorillas in general but to all the living members of the mammalian order of Primates, or monkey folk of all the world.

Mrs. Hoyt begins her story of Toto with a very realistic account of the Hoyts's hunt for gorillas in French Equatorial Africa. The narrative flows along easily and interestingly. One is not likely to put the book aside after beginning the story, for it holds the reader from start to finish. It is a plain and simply-told record of a remarkable achievement: the rearing of an "almost human," orphaned infant gorilla only a few months old, frail and delicate, which in nine years grew to adulthood with a physique more powerful than that of any man and weighing over 400 pounds.

The author tells, in incident and photograph, of the many wonderful traits of the gorilla, and shows that many of its actions and reactions are indistinguishable from our own. Toto displayed every evidence of affection and concern for Mrs. Hoyt but at times, like an unruly child, would push her or tear her clothing. Such occasions arose only as Toto approached maturity but were to be expected more often as she grew older.

It is clear that Mrs. Hoyt's affection for Toto is very deep and sincere and that she understands the gorilla's every whim. She gives much information, in addition, about the care and treatment of the animal both in health and in occasional sickness. What she does not tell is the great courage she showed in handling Toto when the 400-pound baby was disinclined to obey.

H. C. Raven.

CHEECHAKO

- - - - - - by Edgar M. Queeny

Scribner, $7.50

CHEECHAKO can be read for enjoyment and sustained interest, admired for its beautiful illustrations, especially the exquisite color plates, and kept in anyone's library as a permanent fixture.

Mr. Queeny is a sportsman, and his book is the story of a hunting and fishing trip in southern Alaska. He possesses an enthusiastic interest in his subject and an appreciation of so many of the factors which enter into an undertaking of this sort that his book is quite unlike the usual hunting story. The author and his party traveled on the *Westward*, a boat well equipped for these waters and manned by personnel who knew how to explore the natural history resources of such a rich district as southern Alaska.

The itinerary began at Ketchikan and included stops at various places, among them Admiralty and Chichagof islands. The accounts of hunting and fishing incorporate the firsthand experiences of Queeny's party within a background of the extensive experiences of guides and old-timers. The capture of the trophy is a goal, as one would expect, but more than this the reader senses that the chase is just a good excuse to get out into a wilderness and to be ready to drink in impressions.

Photography was a major project and the Kodrachrome pictures used in the book pluck with a nostalgic twinge at the heart-strings of anyone who has seen Alaska, and they should prove a pressing invitation to those who have not had that privilege. I have seen still better photographs than some of those which show bears but, as the author explains, these were taken under trying conditions and the reader may wonder that some of the exposures produced pictures at all.

H. E. Anthony.

STORM

- - - - - - - by George R. Stewart

Random House, $2.50

THIS is a novel; a novel whose heroine is a storm, a devastating storm that swept down upon the California coast bringing with it a million dollars worth of rain to drought-stricken farmers, and a million-dollar loss and expense to the highway crews, telephone and power companies, railroad and air lines.

On the first day a young meteorologist at San Francisco, studying the Pacific weather map notes a minor low pressure area off Guam. Whimsically, he names the potential infant storm, Maria, and with paternal interest watches her development as she rushes across the ocean toward the coast. On the fourth day a ship is badly battered, and crew members are swept overboard; from the seventh to the eleventh days areas of California are pounded by rains, cloudbursts, or heavy snows. Maria dies on the eleventh day, but a daughter storm, born three days earlier, buffets the Middle West and East with high winds and heavy snows before passing out into the Atlantic area on the twelfth day.

The story of the novel is the story of the storm, of its effects on many people and their reactions to it in various and unrelated walks of life.

According to the blurb on the jacket accompanying this book, the author "spent over two years in collecting the scientific and meteorological data embodied in the story and checked the most minute details with recognized authorities before sending the manuscript to his publishers." Certainly, it does explain the major principles of meteorology accurately, simply, and entertainingly.

As a novel, its merit is reflected in its selection by the Book of the Month Club; as a popular exposition of the major principles governing our weather it is worthy of careful reading. Its value is beyond that of pure entertainment.

H. E. Vokes.

YANKEE STARGAZER,

The Life of Nathaniel Bowditch

- - - - - - by Robert Elton Berry

Whittlesey House, $2.50

HERE is a very readable biography of one of the pioneers of astronomy in America. Nathaniel Bowditch ("the 'bow' rhymes with ship's bow," the author reminds us) is internationally known for his book on navigation, which has for nearly a century and a half been referred to as "the Seaman's Bible." And it is still a best seller on the lists of the United States Hydrographic Office, under the title *American Practical Navigator*.

The life story of this self-educated man is a thrilling and inspiring one. He taught himself mathematics and became, by the age of 22, the foremost mathematician in America. He taught himself Latin in order to read Newton's *Principia*. He spent five years on the *Principia* and, incidentally, found an error in the great work. He taught himself French and later translated Laplace's monumental work, *Mécanique Céleste*. This was more than a translation, for he amplified and explained the more difficult parts of this classical treatise on celestial mechanics.

In 1806 he was invited to take the chair of mathematics at Harvard, but declined. In 1818 President Thomas Jefferson sought to bring him to the University of Virginia to teach mathematics, but he refused. In 1820 he declined to go to West Point, where Secretary of War, John C. Calhoun, asked him to come.

Bowditch was a practical navigator. He made a number of voyages to the Indies, and thus had abundant opportunity to test

[illegible]

[illegible]

THE STORY OF THE VARIABLE STARS

by Leon Campbell
and Luigi Jacchia

Blakiston, [illegible]

THE MILKY WAY

by Bart J. Bok
and Priscilla F. Bok

Blakiston, [illegible]

TWO [illegible] Harvard Books on Astronomy [illegible] four of the nine projected, and these two [illegible] ber number of NATURAL HISTORY.

The Story of the Variable Stars will be [illegible] servers, for the senior author is the dean [illegible] phenomena, and at the same time he has for many years been the leader in organizing, directing, and inspiring amateurs in the phases of this type of research in which they can do work of value.

Parts of the book are rather detailed for the layman but these can be left as suggested by the authors for the actual variable star observer. But all will be fascinated by the story of the Cepheid variables and their period-luminosity relation [illegible] epoch-making advance in astronomy that this reviewer has read. Another outstanding feature of the book is the story of the novae, the most spectacular stars in the sky.

Besides the short-period variables (Cepheids) and exploding stars (novae), all other types of variable stars are treated in the light of the latest research. Altogether it is an excellent and authentic little volume.

[illegible] the Milky Way is a stimulating presentation in semipopular form of the history and present status of the exploration of our Galaxy. This great lens-shaped aggregation of 200 billion stars, [illegible] years, would seem a large order for a small book. But the authors have undertaken the task with enthusiasm, and have finished it in a manner deserving the highest praise.

Our Milky Way was called the Galaxy long before we knew anything about its real structure, or that our sun is a part of the Milky Way Galaxy. The story is told of the unfolding of our comprehension of this vast system of stars, 100 thousand [illegible] measuring its dimensions and that of determining [illegible] Milky Way Galaxy is rotating on its axis at a speed that carries our sun around at the amazing [illegible] forth.

[illegible] discussed are: bright nebulae in the Galaxy; [illegible] nebulae; interstellar gas; and the age of the Milky Way.

In a pocket inside the back cover are two superb photographic charts, one of the northern Milky Way and the other of the southern Milky Way. Another feature of the book that should be commended is the inclusion of portraits, scattered through the book, of 30 of the leading astronomers who have added to our knowledge of the Milky Way Galaxy.

CLYDE FISHER

SOUTHWESTERN ARCHAEOLOGY

by John C. McGregor

John Wiley, $5.00

THIS 400-page volume, illumined by 70 photographic illustrations and 168 drawn figures, maps, and diagrams, seeks to sum up and arrange in chronological order the vast fund of knowledge accumulated mainly by American students of southwestern archaeology during the past 100 years. It is high time this task was accomplished, and it is fortunate that it could be done by one who lives and works in the field. There have been earlier and more or less incomplete attempts, but on a field so large and so invitingly rich, constantly being worked, a general presentation is soon out of date. This will doubtless happen again. Meanwhile specialization along various lines is well under way and it becomes a question whether in another decade or two any one student could by himself execute what is here achieved.

The author, after an introductory outline of the subject, presents a brief history of general exploration and the main steps in the more and more serious investigation from 1540 to the present day. He next defines his aims and methods, considers the problem of classification, explains the all-important subject of tree ring dating, and briefly treats ceramics as a main key culture trait. With this as background, he proceeds to describe in some detail the long succession of partly contemporary culture stages from the still questionable Mohave and Abilene finds (dated 20,000 B.C.) and the more certain Cochise, Folsom-Yuma and allied complexes (dated 8000 B.C.) through the more distinctly characteristic Mogollon, Basket-maker, Hohokam and Pueblo developments down to historic times, giving as far as possible the time and space ranges for each. In this connection it is of interest to note that the absolute chronology, as determined by the tree ring method, has now been carried back [illegible]

The book deserves a critical review such as is not possible here. Slightly disappointed with the first few pages, the reviewer found himself more and more impressed with the presentation as he read on. Altogether the text with Appendices, Bibliography and Index makes a book which no Southwestern student can afford to ignore.

N. C. NELSON

FIELD BOOK OF SNAKES OF THE UNITED STATES AND CANADA

by Karl P. Schmidt
and D. Dwight Davis

Putnam, [illegible]

THIS volume of the widely used Putnam series of field manuals conforms to the standards of the volumes already published. Preliminary chapters summarize folklore, history of the study of snakes in the United States, poison apparatus and treatment of snake bite, habits and behavior, methods of collection, preservation, and study. The remaining three-quarters of the book are devoted to simplified keys, brief descriptions, statements of range, and ecological notes. References to papers dealing with individual genera are included in the text, and a list of references at the back of the book provides general references as well as lists of the more important papers available for each state.

The identification of all recognized species and subspecies within the United States is made simpler by inclusion of 103 line drawings, four color plates and 82 photographs. This compact volume will be extremely useful to teachers, naturalists, and herpetologists, despite a tendency toward oversimplification. Subfamilies and suborders have needlessly been elevated to families and orders, and otherwise good line drawings seem to have suffered from printing on inferior paper. A better binding and better paper are warranted both by virtue of excellence of the text and by the price.

C. M. BOGERT

THE MORNING STAR RISES

An Account of Polynesian Astronomy

by Maud Worcester Makemson

Yale University Press, $5.00

IN this scholarly work, Doctor Makemson has contributed greatly to the subject of primitive astronomy. This book will find its real audience among those whose broader interest allows not only for exact modern astronomical statistics and theories, but also for the astrological and imaginative astro-mythological concepts out of which, or on top of which, modern astronomy has grown.

The Morning Star Rises is not a book for the average layman, but should be of the greatest interest to students of the history of navigation, to those interested in astronomical origins and cosmologies, and to students of Polynesia. Here, in this specialized history of the Polynesians, are shown many of the most practical uses of astronomy throughout the ages.

Divided into eight main sections, the book deals in much detail with early Polynesian navigation by the stars. While the main slant always remains astronomical, there is included much fascinating material concerning the rituals and the hardships surrounding these early voyagers across unknown seas. Much of the book also is devoted to the Polynesian conceptions of the origin of the universe, a mythology quite as interesting as that of the Greeks or the Egyptians.

Among all primitive peoples a knowledge of the seasons and a workable calendar have been of the greatest importance. Doctor Makemson devotes one chapter to a study of the Polynesian calendar, its eccentricities, and its improvements. The Polynesian astronomer, as was true of most primitive astronomers, was also an astrologer, a "wise man," watching the sky for omens, and foretelling the future by the positions and appearance of the heavenly bodies. Sun and moon, as well as other celestial bodies, were regarded as deities. Included is a list of 772 heavenly bodies with their Polynesian names and, in many cases, their modern equivalents. There is also a description of one of the most important institutions of the Polynesians, the Astronomical School, in which young men acquired their detailed knowledge of the stars.

MARIAN LOCKWOOD.

MAN AND THE VERTEBRATES (Third Edition)

- - - - - - - - - by A. S. Romer

University of Chicago Press, $3.50

THE new revised edition of A. S. Romer's *Man and the Vertebrates* will be most welcome in the classroom and laboratory of all the biological sciences. The first edition, which appeared in 1933 as the first of the New Plan texts of the University of Chicago, was among the best on vertebrate evolution. This new edition now tops the list in the field. Approximately two-thirds of the original text has been retained, but it embodies many changes and is brought completely up to date. To this is added a 26-page chapter on the frog, which is especially written to aid the student who uses this animal in the laboratory. Much of the sections on the higher fishes and on birds have been rewritten, and most of the parts dealing with fossil man and modern races are new. So many, and very favorable, changes have been made in the illustrations that the book hardly resembles the first edition.

Professor Romer makes perfectly clear the purpose of each part of his book, but that there is an inequality in treatment of the different subjects seems a valid criticism. For example, in a work of this type to devote 26 pages to the frog and only one page to such an important group as the insectivores seems a bit incongruous. The rodents get two pages. It should also be mentioned that in this one-page treatment of those ancestors of all the higher mammals, the author follows the older view that the tupaioids are insectivores instead of Primates. In general, however, the chapters dealing with the direct story of man's evolution from the earliest known vertebrates are excellent. Those of us who teach a course on the evolution of Man, however, cannot help wishing for a greater elaboration.

In this book Romer has made a splendid contribution. All teachers of elementary biology, comparative anatomy, and vertebrate paleontology ought to read it and recommend it to their students.

ERICH M. SCHLAIKJER.

DOCTOR WOOD, Modern Wizard of the Laboratory

- - - - - - - by William Seabrook

Harcourt, Brace, $3.75

THIS is a biography of Robert Williams Wood, long-time Professor of Physical Optics in Johns Hopkins University. He was 70 in May, 1938, and would normally have been retired as head of the Physics Department in that institution, but instead of being retired as "Emeritus" he was appointed Research Professor of Physics in the same university, and he is still going as strong as ever.

As a boy he was greatly interested in making things,—gadgets, and especially explosions—, and he liked to play outrageous pranks. His inventiveness has increased, and his imagination and sense of fun have certainly not grown less as he has grown older. In short, he has not grown up, and, of course, there is no hope that he ever will.

The book contains the stories, stripped of legend, of so many of his pranks that it is fascinating reading for these alone,—how he determined the composition of boardinghouse hash with the spectroscope; how he scared some darkies nearly to death by spitting fire into a rain-water puddle (this trick was accomplished with a bit of metallic sodium); how he kept cats off the back fence by placing on it sensitively explosive tri-iodide of nitrogen; how he offered his biographer a *handful of fire*,—to mention just a few. He was not what we ordinarily call a practical joker, —his biographer calls him a poltergeist.

When we consider his little book, *How to Tell the Birds from the Flowers*, which is now in its nineteenth edition, and its sequel, *Animal Analogues*, we are reminded of Lewis Carroll (C. L. Dodgson, the mathematician) and his *Alice in Wonderland*. When President Theodore Roosevelt saw the book on birds and flowers, he asked to see more of Wood's writings. So Wood sent him his textbook of *Physical Optics*!

His scientific work was in various fields, with an emphasis on the physics of light. He is responsible for the "electric thaw" that unstops our plumbing; the use of atomic hydrogen in the nonoxidizing welding process; the beginning of the sodium vapor lamps; the first photographs by infrared light; a beacon-lamp using ultraviolet radiation, that enabled convoys to maintain formation at night while remaining invisible to the periscopes of submarines; hundreds of other similar feats. One must read the book to realize the originality and scope of his experiments. Of interest to students of science is a list, in the back of the volume, of 263 of Doctor Wood's scientific papers.

CLYDE FISHER.

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Handy Gadgets for the Nature Photographer

By CHARLES H. COLES

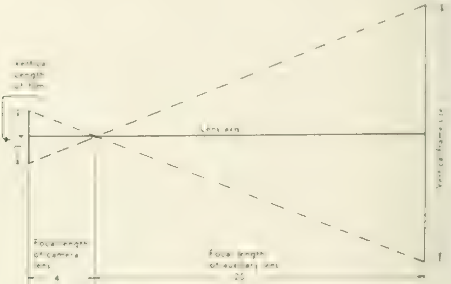
M[illegible] find their place in his accessory kit.

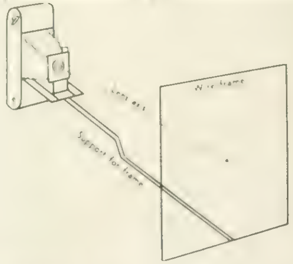
[illegible]

[illegible] ratus as in close-up nature work, where it is necessary to reveal the tiniest details of [illegible] cusing closer than six feet; yet to capture minute details it is necessary to approach much closer than this. Just as the eye of the inquisitive nature-lover makes use of [illegible] that have detachable [illegible]

The auxiliary lens

[illegible] will solve the problem. The auxiliary lens [illegible] this type of lens is that its focal length must equal the distance between the object to be photographed and the camera. For instance, if placing the camera ten inches from the object will give an image of the desired size, then the auxiliary lens you use must have a focal length of approximately ten inches. These auxiliary lenses can be simple plano-convex lenses as long as the camera lens is stopped down well when the picture is taken.





[illegible] subject, the farther the lens must be moved [illegible] extension tube between it and the camera. [illegible]

[illegible] lows is that the diaphragm markings on the camera lens itself are still valid and [illegible] cial computation. When the extension tube [illegible] meter must be increased to compensate for the added distance the light must travel after passing through a lens of a given

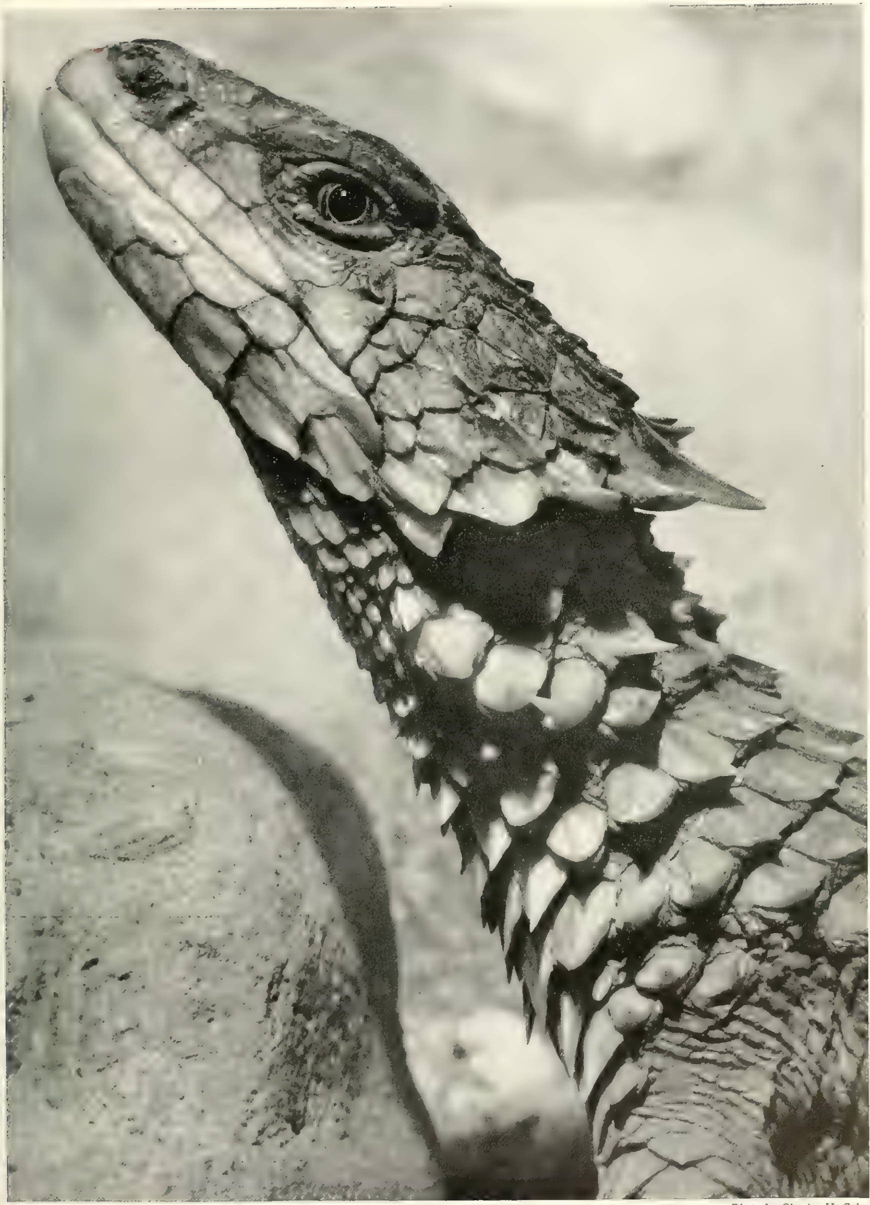


Photo by Charles H. Coles

THIS MIGHT BE a picture of a dinosaur but actually it is a portrait of a live Zone-tailed Lizard whose head measures two and one-quarter inches in length

HANDY GADGETS FOR THE NATURE PHOTOGRAPHER—

[illegible]

[illegible]

Method of [illegible]

[illegible] Graflex and reflex cameras, however, it is [illegible] used successfully with live and active animals. It also requires a tripod.

The second method, while extremely rapid in action, is restricted to the Contax and the [illegible] fastened to the top of the camera and an auxiliary lens over the taking lens, the photographer watches the subject through [illegible] the subject, until the two images on the window merge to form one. When this has been accomplished, the area shown in the view-finder is exactly that which the camera will take, and at the same time the [illegible]

[illegible]

[illegible] exact field cannot be purchased but must be built by the owner of the camera. The [illegible] tangular frame made of heavy wire or small channel metal. This frame is connected rigidly to the camera by means of a bar which is screwed to the tripod socket of the camera. The object in using the [illegible] when it is fitted with a given auxiliary lens. This is the only practical method of equipping the simple bellows camera for close-up nature photography. The steps for obtaining the proper dimensions for the frame are as follows.

First, the focal length of the auxiliary lens must be known. If it is not known, determine it by focusing sharply the image of the sun on a sheet of paper, then measure the distance from the auxiliary lens to the paper. This distance will be the same as the distance between your frame and the lens. To determine the size of the frame, take a large sheet of wrapping paper and at one side draw a line which is equal in length to one side of your negative. If your camera takes a 2¼ x 3¼-inch picture, draw a line two and one-quarter inches long. Now draw a perpendicular to this line from its center and extend the perpendicular right across the sheet of paper. This represents the optical axis of your camera. The next step is to [illegible] focal length of the camera lens; that is, [illegible] 20 inches. At the 20-inch mark, draw a line at right angles to the lens axis. Now [illegible] two and one-quarter inch line through the focal point of the camera lens and extend [illegible] through the 20-inch point. The distance between the optical axis and this last intersection will give you half the width of your frame. The height of the frame can be found in the same way, by lengthening your original line to represent not the width of the film but its length.

In use, the home-made focus-finder is attached to the camera by means of a bolt that fits the tripod bushing. The camera lens is set at infinity and the auxiliary lens slipped into place over it. The whole camera is now moved toward the subject until the subject is surrounded by the frame. The close-up taken in this manner will be found to be sharp and clear. This method is excellent for flowers and similar subjects.

The importance of close-ups in natural history photography cannot be overestimated. Whether the picture be taken to satisfy the cameraman's curiosity or to illustrate a point in the teaching of natural history, the need is vital for sharp rendering of the most minute details. Equipped with whichever close-up device will best serve his purpose, the photographer stands ready to reveal the delicate veining of a leaf, the graceful outline of a flower, or the beauties and oddities of the smaller things of woods and fields.

LETTERS

Sir:

I have been impressed by the potential value, for student use, of the charts you have been printing lately on the center double page of NATURAL HISTORY. . . .

[illegible]

[illegible]
Lennoxville, Quebec.

Sir:

. . . I subscribe regularly to your magazine, which I value above all others, and [illegible] invaluable as an aid and source in the teaching of General Science. The numerous charts which frequently are included in an issue are fine educational material and beautifully gotten up. Your handsome offer to send a corrected copy of the Dinosaur Chart free to all subscribers who request it merely confirms my pleasant impression of the really valuable, accurate [illegible]

I hope that the war does not interfere with the work which the Museum is doing, because I consider it to be of the utmost importance that such work as yours be carried on without interruption.

[illegible]

Poughkeepsie Day School
Poughkeepsie, N. Y.

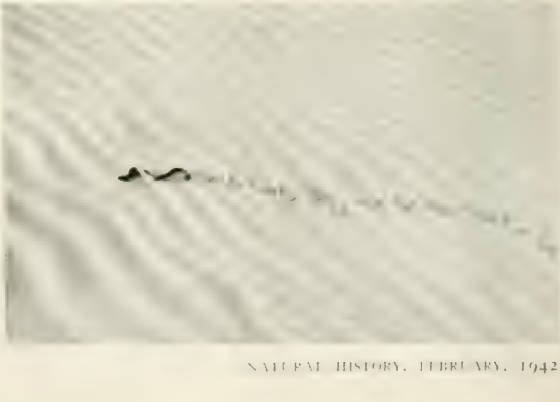
Sir:

The accompanying photograph might be called "Journey's End." This "puff adder," or hog-nosed snake, had crawled at least a quarter of a mile over a sand dune in North Carolina and could go no farther. What his destination was we cannot know, as he was headed toward the very top of the dune. About two hours after the photograph was taken, he had managed to wriggle around and had started to backtrack on his trail, which by that time had been obscured by blowing sand.

The study of his trail gives a good idea of how Mr. Snake moves along over a surface of sand.

[illegible]

Johns Hopkins University
Baltimore, Md.



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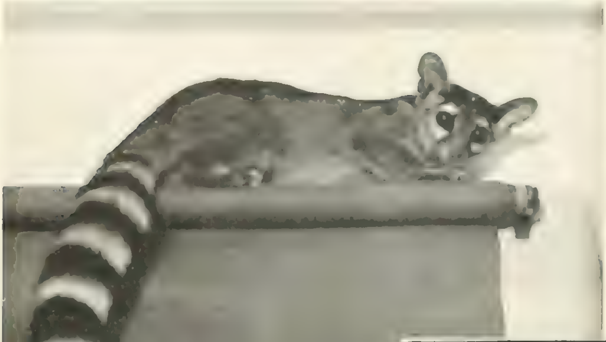

The ring-tailed cat above is a cousin of the racoon, and you will find him in our own Southwest and Mexico. The lemur at right, which so closely resembles him, is really a near kin of the monkeys and lives all of 10,000 miles away, in Madagascar.

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THE MUSEUM IN WAR

This war differs from earlier struggles in that even noncombatants seek no leave of absence. Its onset finds American civilians with their eyes open to the fact that total war spares no one. It follows that the Museum and its resources become part of the unswerving drive to victory.

What is the Museum? It is so many things that the question cannot be answered simply. Like all living institutions, it is first of all the men and women who make up its staff, its trustees, and others who put its goods to use. As regards individuals, its sinews of war have already been aligned through calls from the National Research Council for minutely classified personal information. Many members of our corps, in addition to those joining the armed forces, are being drafted for full or part-time duties "for the duration."

In another sense, the Museum is the aggregation of treasure and equipment that forms the medium in which the staff expresses its discoveries and conclusions. By means of special exhibits, by a fresh approach to those already on display, by instruction keyed to the necessities, the Museum can be of greater effectiveness in working toward victorious peace. The smoke of Pearl Harbor had not blown away before the Administration began to inquire as to what contributions to the prosecution of the war could be made by the staff, and what aspects of the Museum's regular function should be emphasized for the benefit of the public it serves. The prompt findings covered an astonishingly wide range of human knowledge and interest, so extensive that it would be impossible to cite one item of our educational and moral ammunition without slighting a hundred others. No time has been lost in an effort to make our store of cosmographic, biological, and anthropological information directly applicable to the singleness of purpose that fills all minds today.

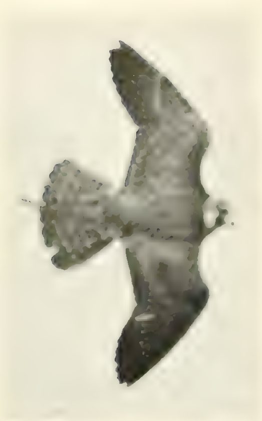
Quite aside from these timely opportunities, we cannot afford to forget that the routine work of the Museum, now as in normal days, is of the sort that stands high in any list of the world's intellectual, esthetic, and spiritual needs. Glance through a tabulation of the scientific departments, and linger over the significance of the research and exhibits that the mere terms encompass:

Anthropology: the science of man and his multifarious culture. Its learning has been distorted by tyrants to conjure up social philosophies as absurd as though the whole earth were still in the Dark Ages. Only a sound understanding of "race" and of the basis of human motives can keep mankind from slipping back again into the abyss. Mammals, Birds, Amphibians and Reptiles, Fishes, Insects, other Invertebrates. Thus tossed together, the strictly zoological departments suggest a flood of ideas, out of which we may snatch only a random few that are applicable to all life as well as to war: food, domestication, transportation, flight, streamlining, parasites, insect-born disease, insulation against heat and cold, competition and co-operation. Comparative anatomy, Animal behavior. The roots of man's curious and sometimes subhuman actions, as well as of his structure, begin far back in the kingdom of his fellow inhabitants of our planet. Nothing is better suited to make him humble, tolerant, and aspiring than to recognize the homologues of his own manners and customs, no less than of his bones and viscera, in his lesser brethren. Forestry and Conservation. "Conserving wildlife is promoting the best possible world for ourselves." Increasingly important in time of peace, the messages of this department become doubly so in war. We must never forget the tragic lessons of the last war in relation to the economy of Nature—when, for example, our "Dust Bowl" was born. Paleontology. We recall vividly a fighting man, named Clemenceau, who came direct from the pier in wartime to see our skeleton of *Tyrannosaurus*. Perhaps he cogitated upon the fact that, time and again, bulk and ferocity have passed away, to be succeeded by smaller mass and better brains. Is it too late to believe that the meek shall inherit the earth? Geology and related sciences. One of the avowed objects of the aggressors is mineral wealth. The President of the United States has pledged that, after our triumph, access to it will not be denied the vanquished. Astronomy. One's thoughts might begin, closely, with navigation, but they soon leap to realms where only the words of the Psalmist apply.

The conclusion is inescapable that the Museum helps to create winning morale, for the course of combat and the peace that must follow, by lifting millions of human beings out of the narrowness of their forebodings and prejudices into a view of the age, depth, and spaciousness of Nature, of which man is but a small part. Furthermore, since even total war leaves the majority of our population to carry on with the ordinary occupations of life, and to make the most of added difficulties, our task in war as in peace remains to keep the ever-probing, ever-changing tools of our science under the fixed light of a principle of the Museum's founders. This, as often repeated by the late President Henry Fairfield Osborn, is that the Museum must, above all else, stand fast as a temple of Truth.

Robert Cushman Murphy

The American Museum of Natural History



An unusual photograph of a Peregrine falcon in soaring flight, taken by George G. Goodwin. The bird has banked sharply, exposing its back. Note the falcon's straps, or jesses, extended from the feet, and the head of the hawk turned to watch the falconer's lure

LETTERS

Sirs:

[illegible]

[illegible]

Sirs:

[illegible]

[illegible]

Sirs:

[illegible] lications devoted to photography. . . .

[illegible]

New Haven, Conn.

Sirs:

[illegible] cember article on dinosaurs . . . I can't [illegible] keep up with the latest scientific theories [illegible]

[illegible] SMITH.

Camp Joseph T. Robinson
Little Rock, Ark.

Sirs:

[illegible] of your recent fine articles on these subjects and your clever original charts.

A. H. CLEVELAND, M. D.

St. Louis, Mo.

Sirs:

. . . While I find your magazine superior [illegible] cially to be commended for the excellent layout of NATURAL HISTORY.

[illegible]
[illegible] Department

Phillips Exeter Academy
Exeter, N. H.

Sirs:

. . . I have enjoyed my previous issues [illegible] source of great enjoyment in my home.

[illegible]

Hawthorne, Calif.

Sirs:

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Lands of New World Neighbors (New Horizons: C.B.S. School of the Air.) The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

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FRIDAYS over the Columbia Broadcasting System Network from 4:15 to 4:30 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.

topic in connection with our biology course in Central High School. This chart as well as several others should be of great help to clear up obscure points in a general way. I would like to have them larger to hang on the wall and be visible to the entire class at once . . . R. D. HISSONG.

Sioux City, Iowa

It has unfortunately not yet been possible to print enlarged copies of the charts referred to.—ED.

- - -

SIRS:

Can you supply reprints of the valuable article on the Bataks of Sumatra, "The Spirits of Batak Land" . . . I could use eight reprints for students in a course in Malay Ethnography . . .

ROBERT M. ZINGG,
Department of Anthropology.
University of Denver
Denver, Colo.

NATURAL HISTORY Magazine regrets that no separates of this article were printed and that copies of the issue containing it would have to be purchased, at 50¢ each.—ED.

. . .

SIRS:

. . . I wish to express my high opinion of the increasing progress of the Institution and of the Magazine, the contents of which are always most interesting . . .

DR. ALBERTO E. J. FESQUET.
Buenos Aires, Argentina

. . .

SIRS:

. . . The enjoyment I receive from NATURAL HISTORY grows each year. It seems to me the issues of each month surpass the ones before in beauty and timeliness . . . EDNA F. DENNISTON.
Rockville Center, L. I., N. Y.

Continued on page 183

Gulls in winter plumage form a beautiful pattern of wings in this remarkable photograph by Charles F. A. Gallagher

NOTICE Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

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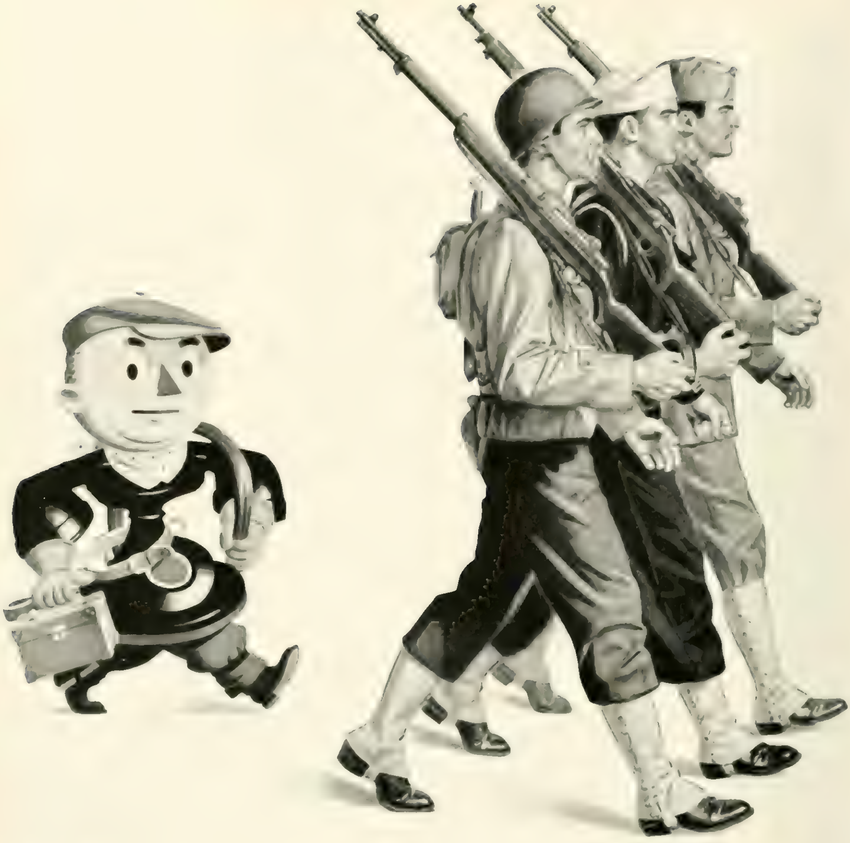

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VOLUME XLIX—No. 3 ★ ★ ★ ★ ★ ★ **MARCH, 1942**

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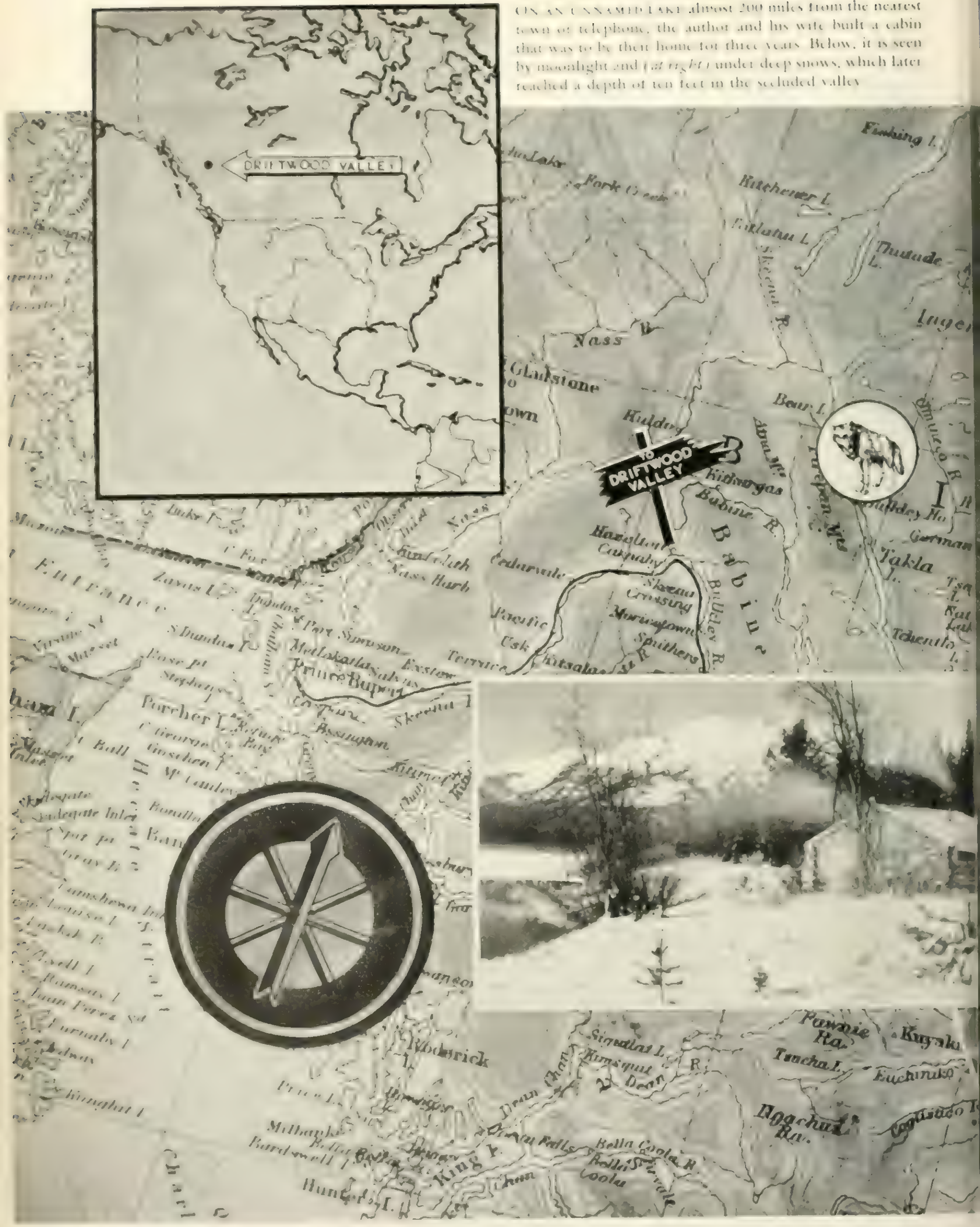
ON AN UNNAMED LAKE almost 200 miles from the nearest town or telephone, the author and his wife built a cabin that was to be their home for three years. Below, it is seen by moonlight and *(at right)* under deep snows, which later reached a depth of ten feet in the secluded valley


DRIFTWOOD VALLEY
TO DRIFTWOOD VALLEY
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Kitchener L.
Thutade L.
Skeena R.
Nass R.
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Ocean Falls
Dean Chan.

Three years in the WOLVES' WILDERNESS

A man and his wife make their home far from civilization in British Columbia's vast solitude to study wildlife amid mountain scenery of surpassing grandeur

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By JOHN F. STANWELL-FLETCHER

PHOTOS BY AUTHOR EXCEPT WHERE OTHERWISE DESIGNATED

On a rainy August morning in 1937 my wife and I set off into the mountains from Hazelton, British Columbia. We were in search of a spot somewhere in the 800 square miles of the wild, uninhabited Driftwood Valley where we could build a cabin home and live a peaceful, simple life, in natural surroundings; where we might find an existence which would lead to a greater mental and physical health than that which was lived by most of our friends in towns and cities. We were not on a big game hunting or scientific expedition. We wanted to study the wildlife in natural conditions throughout all the seasons, especially during the long months of a northern winter. Our collections and observations were to be made on behalf of the British Columbia Provincial Museum at Victoria.* For the greater part of three years we studied the wildlife and we worked to live, a none too simple business in a northern wilderness.

After traveling almost 200 miles from Hazelton we found for our home a lovely little lake surrounded by great mountains and spruce forests. It was an

Photo by T. C. Stanwell-Fletcher

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* "Naturalists in the Wilds of British Columbia," *Scientific Monthly*, January-February, March, 1940. Lists of all plants and animals collected in the Driftwood River Valley are being completed for publication.

[illegible] The nearest settlement, composed of a Hudson's Bay Company trading post, a few white trappers and prospectors, and some Indians, was [illegible] miles to the south, at Takla Landing. A few Indian families lived 30 miles to the north, at Bear Lake. We were cut off from all communication with the outside world for months at a time. We had no radio [illegible] two years and we were entirely alone. Our contacts with humans came [illegible] during the winter when we [illegible] saw the few Indians whose trap lines were in the Driftwood Valley region.

We hiked and climbed over mountains and valleys, easy going and hard going. Our snowshoe trails radiated from the cabin over many miles of territory, and by the end of the first winter dozens of tall trees had sheltered the beds of spruce and balsam boughs where we had slept, sometimes in temperatures of 50 degrees below zero and with eight to ten feet of snow. Often we reached places where no white man had ever been before. This immense forested mountainous land, which we had for so long wanted to see, was very beautiful at all seasons and especially in winter. It was kind to us sometimes, and sometimes it was harsh and inhospitable and bitter, but we loved our life there and were very content.

Our cabin is situated at the northern end of a small spring-fed lake which drains into the Driftwood River by a short channel. The surrounding country supports mixed forests of spruce, balsam, pine, and poplar. Numerous lakes, beaver ponds, sphagnum bogs, and mountain streams thread the entire district. The Driftwood River, with its gravel bars and log jams and marvelous Dolly Varden and rainbow trout, winds its erratic way through the center of the valley, between the Driftwood Mountains on the west and the Omineca Mountains on the east. To the north of the valley lies Bear Lake, while Takla Lake, 50 miles away, bounds the southern end. Most of the country west of the Driftwood River is cut by high mountain ranges and long ice fields. It has not yet been explored or surveyed, and only a small portion of the valley is known to the white man. In winter the valley is particularly isolated, and the wildlife probably approximates a natural state.

The most common mammals were moose, wolves, black and grizzly bears, beaver, otter, marten, fisher, mink, varying hares, weasels, red and flying squirrels, chipmunks, and a variety of mice and shrews. On the mountain ranges, mountain goat, marmots, porcupine, and some caribou were to be found. With the exception of some of the smaller mammals these animals were inaccessible and very difficult to observe. The bird life of this region was fairly abundant; we noted a total of [illegible] species.

Of all the wild animals around us we were perhaps most interested in the timber wolves, those beautiful and most highly intelligent animals of the northern wilderness. The writer was fortunate enough to observe wolves at distances of fifteen to 75 feet on at least [illegible] occasions during 1941, and it is from these personal observations, together with reports from local Indians and notes made during fourteen years spent in those parts of Canada where wolves are found, that opinions have been formed.

As the snow deepened in December, we noted more wolf tracks than the occasional single or double track that had previously been seen. Two wolves ordinarily originated a trail, then other wolves would follow it, each stepping in the other's tracks. The trails usually led through the forests to a moose-yard or its vicinity, where the moose fed on tall grasses below thick spruce trees. But there was little snow under these trees, and the moose was seldom attacked, for its hoofs are sharp and deadly when it has firm footing.

By the first of January, Indian trappers began to report small and large packs of wolves. All of these were seen traveling along the edges of lakes. They were in groups of from four to 31, moving slowly and in single file. By the end of January, with six to eight feet of snow, the wolves began to hunt moose in earnest. Deeper snow beneath erstwhile sheltering trees forced the moose to travel farther for food, and in deep snow they were easy prey for the wolves. Within an area of five square miles just north of us, seven moose were killed by wolves during the winter of 1938-39. Although all of these were not eaten at once, the wolves returned and cleaned up the carcasses later.

At this time of year, the weather obliges the wolf to subsist chiefly on moose flesh, fresh or ancient. In the deep snow the lightweight snowshoe rabbit can easily avoid the heavier wolf; and grouse and ptarmigan cannot easily be stalked by an animal that sinks to the belly or lower with each step. Only the moose, whose great weight forces him to travel with bent forelegs used as snowshoes, can be hunted successfully. That the wolf's food is not easily obtained even then, is evident when one follows a trail in the snow. We have the skull and skin of a large black dog wolf which was found alive with broken ribs and leg bones, underneath a tree. Surrounded by moose tracks, blood patches and moose hair, the wolf had been crippled in a great battle. Similar cases were frequently reported by Indians and apparently usually occurred when the wolf had attacked the moose alone.

The power and endurance of wolves is astonishing. We have two large dogs, one of which weighs a little over 100 pounds. He is remarkably powerful—capable of carrying a 50-pound pack for eight hours and then romping playfully after the pack is removed at camp. Without the aid of a snowshoe trail these two dogs were physically incapable of traveling more than five miles in one day through the six-foot soft snow of the forest. They sank almost out of sight and were forced to make progress by great leaps which quickly exhausted them. Even when following a trail made by two pairs of snowshoes, the two dogs, hardy as they were, soon tired. And yet the wolves, many of them weighing 130 pounds and over, with no broken trail to follow, travel incredible distances.

In one instance, during the first week of February, 1941, I followed two wolves, presumably mates, for 27 miles. The larger tracks were partly obscured by the smaller ones over the first fourteen miles. Then the larger wolf moved to one side, with no perceptible change in pace, and dropped behind the smaller one. The snow was approximately six feet deep and very soft. The track made by these wolves resembled a shallow trench one foot deep and sixteen inches wide, with foot and leg tracks going deeper. The leading wolf simply pushed its way through the snow. After the change in leadership there was one pause—not a rest—where both wolves sprinkled a dead stump. Then they continued on their way. Two days later I followed these same tracks eight miles in the opposite direction, and there was no change in leadership—no sign of rest being taken, just the same deep furrow in the snow, made by a powerful chest. The dog wolf had apparently led for a total distance of 22 miles, breaking the trail without rest. I lost the trail when heavy snow came.

Toward the end of February, after being noticeably silent, the wolves began to give voice. Often on still days or nights the Driftwood Valley echoed with their love song, which is the most beautiful of wild music—markedly different from the hunting cry, which is a prolonged series of high notes, persistent and savage. The movement of packs could be followed by the echo of their voices as they went along the valley. Longer days and ever-increasing sunshine, with cold nights, brought a crust on the snow, and snowshoe rabbits became once more a part of the wolf diet.

It is in February and March that one can find evidence that the big wolves apparently appreciate the beauties of their surroundings. I am aware that this statement may be considered fanciful. But after fourteen years in parts of Canada where wolves are found, and with many opportunities of observing them and their signs, I believe that the timber wolf, in common with many other wild animals, enjoys lovely surroundings.

Within a few minutes' snowshoeing from our cabin in the Driftwood Valley, a hill rising abruptly above a small lake gave a magnificent view of six separate mountain ranges, snow-covered peaks, glaciers, mixed forests, and frozen lakes. In late winter we visited this enchanting hilltop, particularly when the moon's brightness lit up the snow-covered valley and mountains clearly. At the top of "Wolf Hill," as we called it, we invariably found wolf tracks. On the western rim, where there were many open vantage points, we would find the impression of a wolf that must have sat for a long time, facing the best of views. The imprint of the hind quarters was hard and ice-encrusted, such as is left by a dog that has slept in snow all night. Little or no food was to be gotten on this hilltop, for deep snow covered the few mouse holes. Varying hare and squirrel tracks were rarely noted there. Dense forest hid any sign of moving game in the valley below. The wolf tracks always led directly from one vantage point to another. Spots favored by the wolves were precisely the ones where we delighted to linger ourselves because of the view. We were always careful to avoid unnecessary trampling of the snow and left the wolves a clear way to each spot.

Once at midnight on Wolf Hill, while we silently drank in the beauty of a cold February night, with a brilliant moon lighting the entire valley for miles, a wolf immediately below us sent out a call to his mate; a low, musical note, deep and vibrant, more like a movement than a sound. Then he gave a rising, ringing call which faded gradually and ended in two distinct and incredibly low notes. Twice the call went out, and from far away there came an answer, faint but clear. Three more calls and answers rang out before the two wolves apparently came together. Then silence, and we were left with the view.

From our first arrival in the country we made every effort to preserve a sanctuary around the cabin and the lake by which it was built. After two years we were rewarded by an increasing number of observations on birds and mammals. The wolves, perhaps the most cautious and wise of all creatures, began to use our snowshoe trails.

On numerous occasions one or both of us were followed by as many as six wolves, particularly when we traveled at night. Once, as we were returning by moonlight from a long day's trip, I went ahead to start the cabin fire, leaving my wife to travel more slowly a mile or so behind. She was an expert on snowshoes, was always armed, and often traveled alone in this country. With that peculiar sixth sense one acquires alone in the wilderness, she felt she was being followed, though she could hear and see noth-

MANY SNOWSHOE JOURNEYS were made, and many tall trees sheltered the balsam beds where the naturalists slept

A VIEW through the cabin door in early winter, a season in which the wolf chorus was silent and tracks scarce

us. This fact was confirmed the next day by two Indians traveling an hour or so behind us. They had seen the tracks of six wolves closely following the snowshoe trail of my wife. At other times we frequently found fresh wolf tracks made over our snowshoe trail of the day before. We often noted spots where wolves had apparently watched from behind undergrowth as we went by, and their voices were sometimes heard within 100 yards of the cabin. In summer the loud cowbells on our two pack horses seemed not to disturb the wolves, nor did the barking of our big dogs at play.

The wolf and man

Toward the end of our stay I became convinced, by actually watching wolves, who in turn watched me, that they were unafraid and quite familiar with my habits. Possibly they realized that because they were never hunted or trapped by us there was nothing to fear. At the same time, I felt no fear of the wolves—only a tremendous respect and admiration.

There are many stories of European wolves hunting and attacking man, but we have not been able to discover any authentic case of a person being attacked by the timber wolf of North America. It is my belief that there are no authentic cases. Indian hunters, from the Hudson Bay to Alaska confirm this belief. A wolf in a trap will fight and bite, naturally. Wolves do not hunt man; they hunt for food, and man flesh is apparently distasteful to them. The bodies of men who have died in the wilderness remain undisturbed, except by birds and flies, until they rot and are moulded into the ground. Cleaned skeletons are the result of maggots, not wolves. The timber wolf apparently prefers the meat which he kills himself; occasionally he touches kills made by man, but he shows remarkable intelligence in avoiding man-made traps, no matter how cleverly disguised.

In the Driftwood Valley district the wolves are apparently most vociferous in March and August. In late February and March, the love song, so clearly different from the hunting song, is such that once heard it is never forgotten. A pair of wolves begin the chorus, usually in the late evening. Others near and far take up the song in low and high pitch without a discord, and the whole valley resounds with melody. There is something vital and soul-stirring in it, which makes the listener feel that these wolves have a great soul as well as love of life. It is a wild song—everything about the wolf is wild, in the true sense of the word. Wolves, perhaps more than any other creatures, seemed to us to be the spirit of the wilderness itself. Everything that we learned of them pointed to the fact that they are strong, fearless, peace-loving, faithful to each other. With their great intelligence they seem determined to live on in spite of man's attempt to destroy them, in spite of his

THE CABIN late in February, when on still days and nights Driftwood Valley began to echo with the most beautiful of wild music—the wolf's love song. When the trees were bare, the chorus rang clearly. Heavy snow muffled the voices and made the moving pack sound far away

MRS. STANWELL-FLETCHER and the two huge dogs who shared with them the trials of the trail and the comforts of the cabin

(Right) THE COUNTRY around Driftwood Valley is cut by high mountain ranges and long icefields. A scene across Blue Lake

Photo by T. C. Stanwell-Fletcher

(Below) HUNDREDS OF SQUARE MILES of unexplored and unsurveyed land were within reach of the lonely cabin. The nearest Hudson's Bay post was 75 miles to the south. "Sometimes this immense forested mountainous land was kind to us," writes Mr. Stanwell-Fletcher. "Sometimes it was harsh; but we loved our life there and were very content."

Photos by T. C. Stanwell-Fletcher

[illegible]

[illegible] occasions there were the usual low notes, but instead [illegible] clearly that it made the listener smile in sympathy. In late May and early June, when the young were growing rapidly, the wolves were heard more frequently. In the early morning, soft yaps and yelps from young wolves could be easily distinguished, while the older ones gave short cries and lazy howls as though they were just waking.

[illegible] tained and one wolf no longer needs to join forces with others in hunting. Then we saw individual wolves, in many types of country, from valley streams and river beds to snow-covered mountain peaks. On [illegible] One night [illegible] feet altitude. Early in the morning I was rewarded by the sight of seventeen goats who, fleeing from two wolves, ran and leapt where there appeared to be no possible foothold. Eventually they climbed to [illegible] on a rugged, precipitous face of rock.

The summer fish feast

Early in August the clear water of the Driftwood River is turned to red-gold by spawning Kokanee salmon, a small, red, subspecies of the sockeye. For ten days or longer, countless numbers of this fish fight their way up the river, to spawn and then die, fouling the water with their decaying bodies as they [illegible] downstream. Thousands of dead fish are left on the banks and gravel bars, and for a few days a great stench pervades the country, calling all wildlife to the river. Birds, bears, wolves and lesser animals then enjoy a fish banquet. Soon the gravel bars and river shores are clean once more and the stench is gone. For a few more days the wolves move slowly along the banks, fishing for the last of the kokanee. Wading and swimming across still pools, fording shallow rapids, they eat and sleep and sometimes gather together for a song. I was present at one of these song-fests, an unforgettable experience and a privilege which is perhaps seldom granted to man.

For three years we had hoped and tried in vain to get pictures of wolves, particularly in 1941. We had visited and revisited many moose kills, and we had traveled considerable distances during winter and spring to regions where the Indians thought wolves most numerous. We had various harrowing adventures as we blazed our trails over that tough unexplored country. On one trip when loose rocks gave way beneath him, our fine old pack horse "Baldy" fell hundreds of feet down a mountainside. Overbalanced by his pack, he rolled and crashed down the mountain, out of sight. He stopped, feet in air, against a huge dead log, less than ten feet from a sheer drop onto solid rock. A minor scratch and a badly bent frying pan were the only results other than the fright we received!

AT A MOUNTAIN meadow camp, drying meat for future use

THE INQUISITIVE YOUNG WOLF with whom the author played "hide-and-seek." The American timber wolf does not attack man

A COYOTE PUP, kept for four days and then released

Toward midsummer we had almost given up hope of ever getting sufficiently close to photograph even one wolf. Sometimes as we lay in our sleeping bags under the trees, we heard wolves calling. As we climbed the mountains or forded streams we saw wolf tracks. From camps on high alpine meadows, where wolf food was abundant, we hiked and climbed over many, many miles, in hot blazing sun or ice-cold snow and hailstorms. When we returned to our cabin we had given up all hope of pictures. The thing seemed to be an impossible job, but we would make just one more trip.

We were almost ready to depart when we were startled by a sudden outburst from wolves by the river, a quarter of a mile from our cabin. Thick undergrowth, willows, and dry ground made a silent approach to the spot impossible, even though I wore moccasins. As I neared the river all became abruptly silent. For an hour I remained as still as possible, but saw and heard nothing until I returned to the cabin. Then the singing began again from the same place as before.

Still hoping to get pictures, I hurried across the lake in our small, homemade skiff, and, coming to the river, poled my way up as quietly as possible against the rapid current. When I reached the spot from which the singing had come there was nothing but silence. Dozens of wolf tracks had just been made along the shore and sand bars.

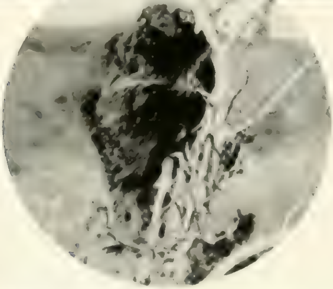
After an hour or more of waiting under a bank overhung with willows a black bear and cub came from the bushes on the opposite shore, 40 feet away.

THE AUTHOR with a Dolly Varden trout fresh from Driftwood River. In August, spawning kokanee turned the water to red-gold, and the animals enjoyed a fish banquet

Photos by T. C. Stanwell-Fletcher

DRIFTWOOD VALLEY. Here wildlife, unlike protected animals in National Parks, was in a more natural state and much harder to observe. The naturalists studied it through all seasons, especially winter

Two Mountain Caribou, a species very much larger than the woodland caribou and reaching a weight of 500 or 600 pounds.



Well protected by its quills, the porcupine lives untroubled by any serious enemies in the Driftwood River region, as elsewhere over most of forested Canada

It was necessary to work to live, and a mountain caribou was welcome food

After winter's heavy snow

Wolves were heard within 100 yards of camp and never seemed to be disturbed by the loud cowbells carried by the two pack horses

(Right) **The author** at 8300 feet in the Omineca Mountains east of the Valley: a vantage point from which mountain goats were observed during the summer

Photo by Indian Sapolio

wers sprang up along the streams

Photo by T. C. Stanwell-Fletcher

Meat for the morrow adds cheer against the flaming sky in a lonely land

[illegible] to hunt for fish. The wolf eventually saw my skiff, [illegible] stillness, he loped slowly and gracefully off, across the river into the willows, where he apparently stopped. The bears moved quickly away, and the next hour or so passed quietly.

[illegible] No sound was heard, and I seemed to have all of that still and darkening country to myself. Then, without any stirring or preamble, wolves began to sing in the willows opposite. The river at that point was shallow and quiet. There were probably ten or twelve wolves, judging from the noise and different voices. They did not move about, just sat still and sang. Each outburst was started by the same wolf, whose voice was the lowest and most dirge-like of any I had ever heard. The volume of sound, its wildness, and the nearness of it all held me spellbound. Seldom is the wilderness so kind to man as to allow him to be present at such a moment.

Grizzly and cub

[illegible] an opening in the willows which marked the end of a game trail. Suddenly there was a crash, and I turned to find a grizzly bear with its cub. They had not seen the boat and were starting to climb down [illegible] foot over their heads. A few more steps and the bears would not have been able to turn round. However, the blinding flash from the gun frightened them properly, and they departed in a hurry. I swallowed and tried to regain composure, feeling greatly annoyed at what I supposed was surely a termination of the singing. But almost at once it began again, from the same place across the river. The wolves were determined to sing; even the loud report of a rifle, so near by, could not deter them.

At this time, my wife was doing home chores around the cabin a mile away; cooking supper, watering the horses, and tying them up for the night. She heard the rifle shot and thought that undoubtedly I had been obliged to shoot a grizzly bear in self-defense, [illegible] shoot at that hour of the night. Then she heard the wolves howling again. It was phenomenal for them not to have been silenced by the rifle shot, and al[illegible] badly frightened. The one dirge-like note of the wolf I have already mentioned, different from all wolf notes with which she was familiar, sounded so like a human voice in pain that she was about to start off into the dark to find me. Luckily I was on my way home by that time, and she heard me paddling up the lake. The wolves were still singing at intervals.

I found that ten or more wolves were in the habit of traveling along the river slowly, up one side and down the other. At one large gravel bar they appeared to spend some time in catching Kokanee salmon; so I went there every morning before three [illegible]

Cold work

[illegible] from the river, which afforded an excellent hiding place. Sometimes I simply sat in the skiff; sometimes I stood in the water in my waders. It seemed to be entirely a matter of keeping absolutely still and waiting indefinitely. Every day, from three in the morning until noon or later, sometimes in the late afternoon and evening, I waited and watched. During that time I saw sixteen wolves, all within fifteen to 75 feet of my skiff. It was the coldest job I have ever known, and the most exciting.

The first wolf I saw was a gray fellow, standing in the water with a flapping kokanee in his mouth. The skiff was moving at the moment, and the wolf saw it at once. For a second he stood still, then lowered his head eight inches, while the hairs on his shoulders rose stiffly. A moment later he loped away. On the fourth morning, after I had sat quietly and shivered in the raw air for two hours, a large yellowish wolf appeared. It moved to the water's edge without the slightest sound, gliding along with the wolf's stiff-legged yet lithe, almost cat-like gait. It pounced on a kokanee, then at the sound of the movie camera stopped dead still. Again the head lowered and the ruff stood stiff. The camera stopped, and what was to become a frequent game began: the single movement of a cramped finger would send the wolf away.

Three more wolves were seen, but in such bad light that pictures could not be taken. They all appeared silently, and were well out into the open before I was aware of their presence. They vanished as soundlessly, stepping over the small stones of the gravel bar as though they walked on broken glass.

As possible bait for wolves I had brought from the mountains the fatty lining of some mountain goat stomachs. No part of the bait had been handled except with clean gloves. As I drifted by in the boat one day I dropped three pieces of it on the gravel bar. The first wolf to appear stood stiff-legged, head low and moving slowly from side to side, inspecting the bar. It was 4:15 in the morning. A minute later the wolf backed carefully away to the willows and vanished. Some time afterwards a low howl came from the willows behind the boat, and I had the feeling that I was being watched. Crows took the bait when the sun came up.

A lonely female

At six o'clock the following morning, with the temperature twelve degrees below freezing and a cold, clammy mist lying over the river, a large coal-black bitch wolf appeared. She was thin and very hungry. Her belly was drawn in, and I had the impression that she was old, without young. Moving leisurely up the gravel bar, she stopped once or twice to catch struggling salmon in the shallows. Then she came to a piece of bait, seeing it without apparently getting the scent first. Without any hesitation she ate the bait. Then she went to the river and caught three more kokanees in rapid succession. A few minutes later she vanished, but she returned in fifteen minutes or so, examined the place where the bait had been, and once more entered the river. At that moment a number of wolves, probably a family gathering, began a song near by. The voices of young puppies were plainly distinguishable, their high quavery notes straining to compete with the louder, more mellow ones of the elders. On hearing this the black wolf waded across the rapid current to within 20 feet of the skiff. Then she leapt up the bank, three feet high at that point, and sat down in the tall grass, showing only a vague outline of her body. She began to sing.

In a low, vibrating dirge she seemed to bewail her loneliness. Not loud, but soft and mournful came the lament, and it was easy to imagine that this wolf had lost her mate and was alone in the world, with only memories of a happy past and of litters of frisky young pups at her side. For perhaps an hour she sat there, then she returned to the water and, approaching the boat to within fifteen feet, buried her head to the shoulders to catch a fish.

It was a moment later that she saw me or heard the camera, and for a long time we watched each other. Her beautiful golden eyes widened. The only other touches of color in the coal black body were her white and gray whiskers and muzzle. Long minutes passed, then she turned slowly, forded the river, stood where the bait had been, and once more looked at me.

With teeth chattering, and belly shivering from the cold, I tried to expose as much film as possible, rewinding the camera with stiff fingers at the moments when the wolf was turned away or had her head in the water. It was with the greatest effort that I could hold the camera even reasonably still. Most of the resulting pictures are shaky.

By August 20th there were few kokanees left in the river. The dead fish had all been picked up, and only one or two struggled in the shallow waters. Almost a week passed with no sight of wolves, although we heard some. Bears crashed around in search of berries; an otter was seen once, and two coyotes. A large number of muskrats appeared every morning.

Hide-and-seek

Then I saw more wolves. The third one was a young male, well fed and strong. His belly bulged uncomfortably, and he moved slowly, though with an air of abandon. Approaching to within 30 feet of the camera, he saw the boat and stopped, leapt back a dozen yards, and then sat down to watch. After a few minutes he came on again, head lowered, ears pricked forward. Once more he sat down and for a few minutes peered this way and that, with head low, then high, staring at the boat with great interest. Then I said "Hello!" The young wolf bounded into the air. For a while he played hide-and-seek with me, in and out of the willows, once interrupting the game for a good long scratch. Then he vanished into the bushes and began to circle the boat. Three times his head showed out of the willows at different places. Later, I thought I saw the same pup twice. On the last occasion I was almost chagrined at his complete disregard of my presence. The young fellow fished and amused himself happily until a call, which must have been from home, came from far away, and off he ran into the forest.

I believe that most of the wolves seen at close quarters were aware of my presence. Since no wolf was shot or harmed in any way by us or others in this area, it seemed probable that they realized there was no danger. Had one of them been harmed, the others would doubtless never have allowed themselves to be seen and watched. I do not believe that wolves are afraid of man; there is nothing even remotely cowardly about their actions. The wolf is a truly wild creature and a very valuable factor in controlling overpopulation of one district by any other race of animal. It is my opinion that bounties on wolves are now, in mose districts, unnecessary and unjust. If the wolf is exterminated we shall have lost one of the most virile, wise, and beautiful of all wild creatures.

STRATEGIC METALS

NUMBER III

CHROMIUM

Now doubly strategic are chromium's corrosion resisting properties

By FREDERICK H. POUGH

C[illegible] like [illegible] from [illegible] and [illegible]ors. Its most familiar use, like that of tungsten, is of relatively little importance in wartime. Just as the filaments of light bulbs use an inconsiderable percentage of the tungsten produced, so does chromium plating use a small quantity of chromium.

Contrary to what might be supposed, plating with chromium is accomplished by a chemical rather than a metallurgical process. In common electroplating, a metal is transferred from one object to another by means of an electric current. The positive terminal, or anode, is an actual bar of silver or other metal as the case may be, which becomes smaller as the metal is transferred through the solution to the object to be plated, the cathode. Chromium however, will not dissolve in this way. Therefore, a soluble chromium compound must be added beforehand to the solution, and the solution must be renewed as the process continues. This procedure is made necessary by the resistance to chemical attack that makes chromium useful for auto trimmings, bathroom fixtures, and cocktail shakers.

The layers are so thin (two-millionths to five ten-thousandths of an inch thick) that the total quantity of chromium utilized in this way is practically insignificant.

There are some other chemical uses interesting and in a way important, but not essential. Our army might look very different were it not for chromium, for chromium is used in the dyes of olive drab. Our soldiers' boots and belts were tanned with the aid of chromium salts. But these are not the uses that place chromium second on the list of strategic metals. The Army and the Navy owe much more to chromium than is covered by the chemical uses.

Chromium plating resists tarnish and corrosion, and this is what makes chromium of value in alloys of steel. Stainless steels contain high percentages of chromium. In addition to its resistance to corrosion, chromium imparts other remarkable properties to steels, depending upon which other metals are added. Nickel and cobalt are commonly used; molybdenum, tungsten, copper, vanadium, zirconium, or silicon may also be introduced. Low chromium steels for armor plate and armor-piercing projectiles, and for gasoline engines, may use from one-half to five per cent of chromium, super stainless steels twelve to 30 per cent. Such steels are for use in chemical plants at high temperatures, where great resistance to corrosion is required. In such alloys nickel may be as abundant as chromium, though usually not. Chromium cast irons and chromium tool steels have also been developed, and in all of them the strength and corrosion resistance are the important properties.

Because chromium has high resis-

An unusual piece of ore from Alaska: the chromite balls are rarely so pronounced. Decorative chromium plating represents one of the best known but least important uses

tance to electric currents and resists oxidation, it is also valuable for electrical heating equipment. Wires for such purposes contain eight to 20 per cent chromium and 54 to 80 per cent nickel, with the balance iron.

Chromite is closely related to the common ore of iron, magnetite. Like that mineral, it occurs in eight-sided crystals, but unlike magnetite it is not magnetic unless the iron content is very high. The chromium content of the ore varies greatly from place to place, even in the richest deposits.

Chromite is a common associate of peridotite or basic rocks (rocks low in silica) and the serpentines so often related to them. Only in such regions, indeed, have chromite deposits been found. Mineralogists believe that the chromite separated from these rocks of low silica content when they were in a molten state, and that it was then perhaps injected as more or less pure masses along with the peridotite. This manner of formation explains the typical deposits of chromite, which are series of lenses of irregular masses, often along the contacts of the intrusion.

When pure, chromite contains 68 per cent chromium oxide, but like most minerals, it rarely occurs in that state. Some of the atoms of chromium may be replaced by iron or aluminum, and some of the iron by magnesium and calcium, through a process common in nature known as isomorphism. The result is that the actual chromium content may be as low as 45 per cent or even less. No one can judge by inspection what the chromium content of ore may be; only by analysis can its value be determined.

Chromium ores too low grade for chemical and metallurgical purposes are still highly valued for a totally different use. In lining metal-treating furnaces, chromite bricks are the only substance that can be used where an inert material is required that will not react to either acid or basic matter. Chromium's high melting point also makes it ideal here. As prices permit, this use is steadily expanding. Forty per cent of the chromite consumed in America goes into furnace linings.

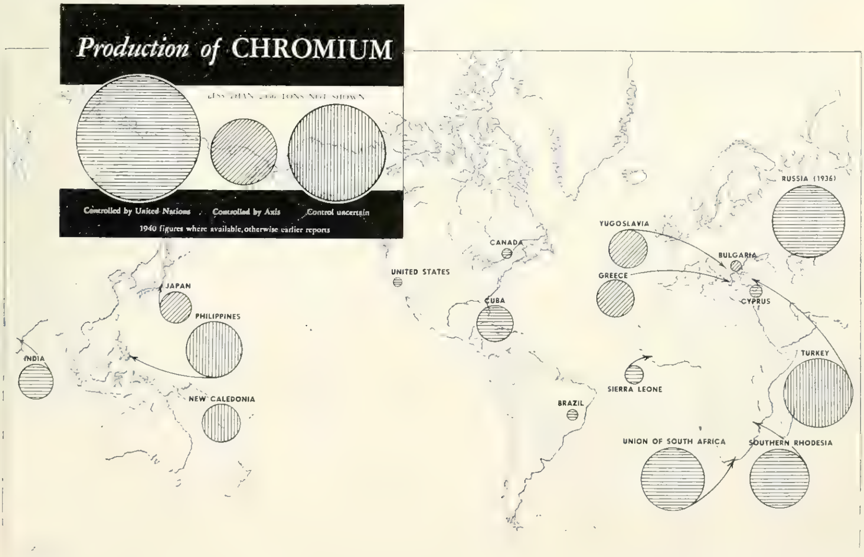
The United States was once, for a brief time, the principal producer of chromite. For a country now having to import so much this seems strange; but in 1827, when mining for chromite was begun in Maryland for a green and yellow paint pigment, we were the only producers. However, Turkish production began in 1860, and the work at that mine finally stopped in 1897. Turkey then led the world for many years but it, too, fell behind as new deposits in New Caledonia and Rhodesia were developed.

The statistics on chromite production are most confusing. Nation after nation developed new chromite resources, which were interrupted and upset by changing conditions of world politics and finance. In 1940 the United States imported over half of the total, and we now probably consume far more than that. Our production, on the other hand, has been less than a fourth of one per cent of the total. Clearly we shall need to import vast quantities to keep our mills going through 1942.

Specialized war uses make chromium doubly strategic. The port of the Garand rifle is made of stainless steel, gears of trench mortars, superstructures of destroyers, armor plate on submarines and battleships,—all require these special steels. Interesting new developments include a method of rolling thin sheets of stainless steel for airplanes, to take the place of aluminum and to be three times as strong. Another process deposits a thin layer of stainless steel on ordinary sheets for lightweight armor plate.

The United States has few areas yielding chromium, and these are small. Certainly we have nothing to compare with the Great Dyke—a sheetlike, more or less vertical intrusion four miles wide and 330 miles long—which is responsible for the important production in Southern Rhodesia. About one-fourth of our imports came

Continued on page 155



NATURE'S PLAYHOUSE

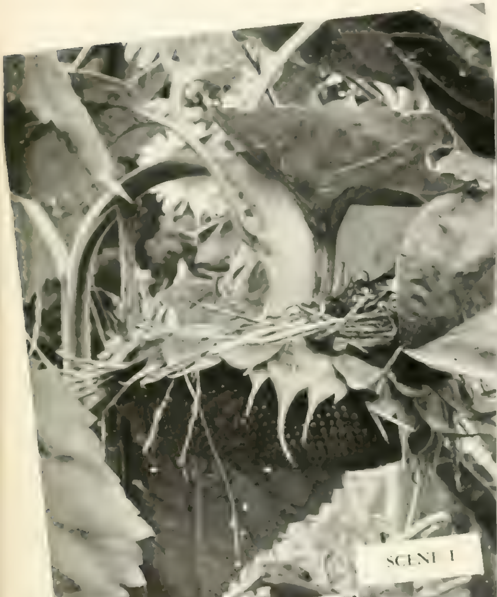
Presents

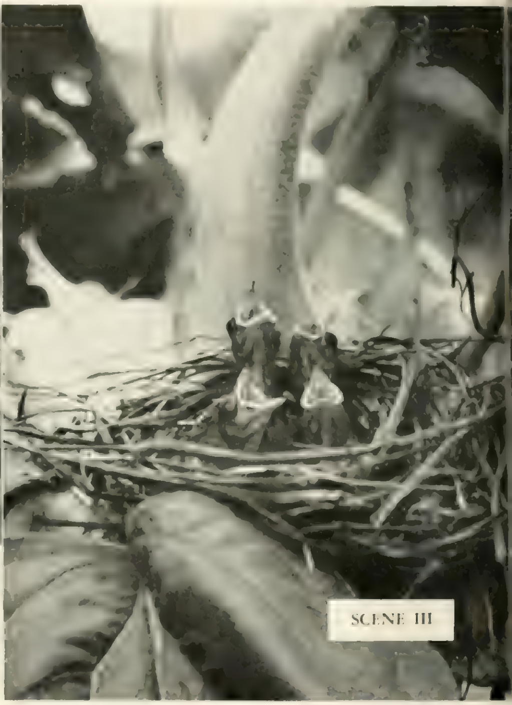
The Sunflower and the Song Sparrow

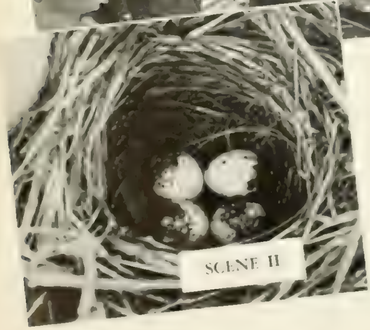
A Nature Drama in Five Scenes

By GEORGE A. SMITH

All photos by the Author


SCENE I


SCENE III


SCENE II

SCENE I The song sparrow built her nest on the turned-over head of a sunflower stalk. Broad leaves protected the nest from sun and showers

SCENE II The nest was lined with long strands of animal hair. In it the song sparrow laid four eggs, covered with numerous rufous-brown spots

TIME: In the month of July

•

PLACE: In the turned-over head of a golden brown sunflower,
growing at the edge of a vegetable garden in Pennsylvania

•

CHARACTERS: A friendly little song sparrow
(Melospiza melodia), and her family of four

•

PHOTOGRAPHY: Kine Exakta, with
Zeiss Tessar f:2.8 lens and extension tube

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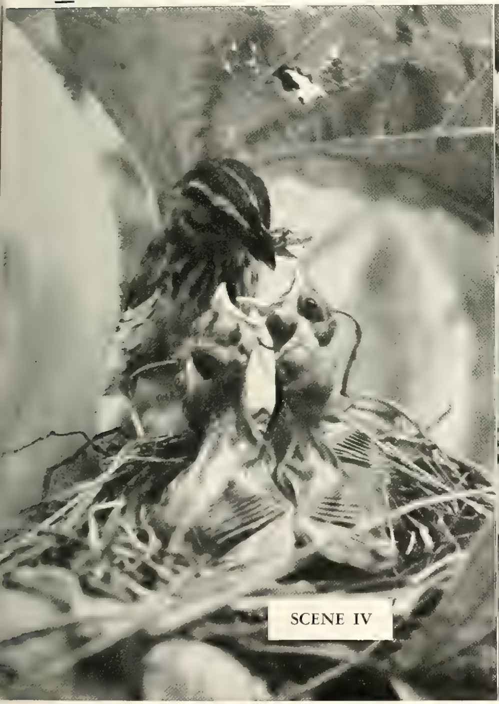
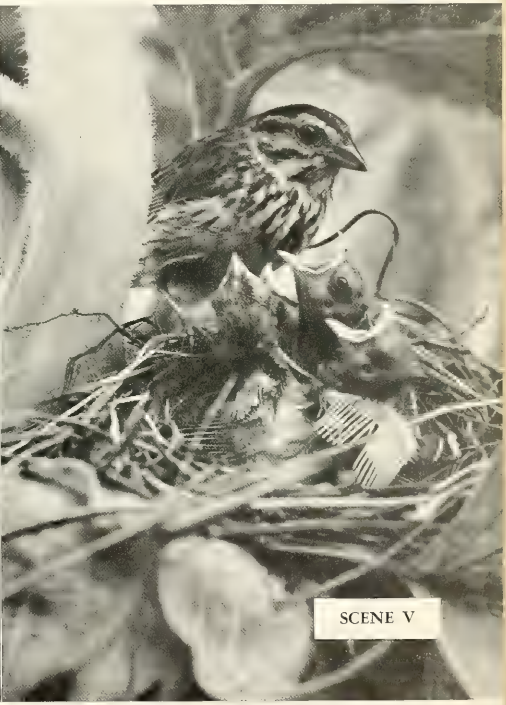
LIGHTING EFFECTS: An overcast afternoon sky

•

PROPS: A blind arranged in the shape of a tent within a few feet of the nest

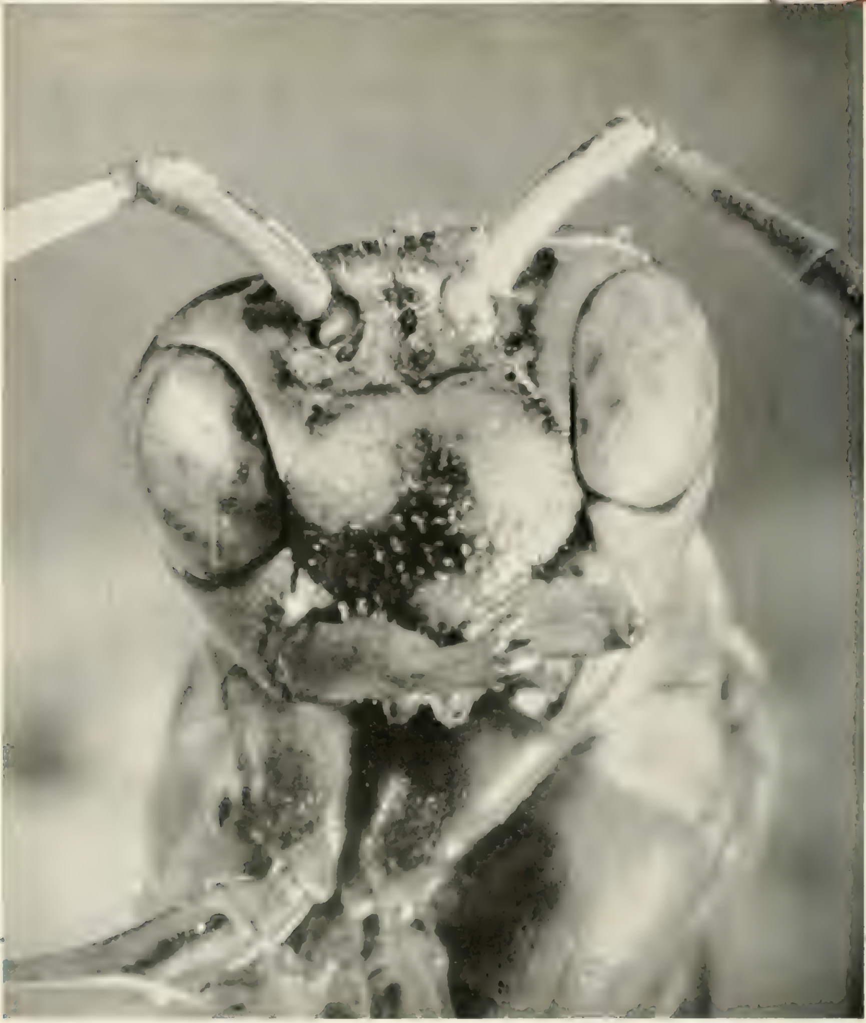

SCENE IV


SCENE V

SCENE III Eventually four little heads appeared, with mouths wide open. Legs and wings were too feeble to support the tiny bodies, but the necks lifted wide-open mouths high above the nest in readiness for food

SCENE IV All four grew well on grass seeds and juicy cabbage worms, until a big grasshopper was only a mouthful. Hair-like down gave way to stubby feathers. Both parents were kept busy

SCENE V After each mouthful, the mother bird paused a few seconds. The squeaky little voices grew louder, promising that next season's meadows would ring again with the characteristic notes of the song sparrow

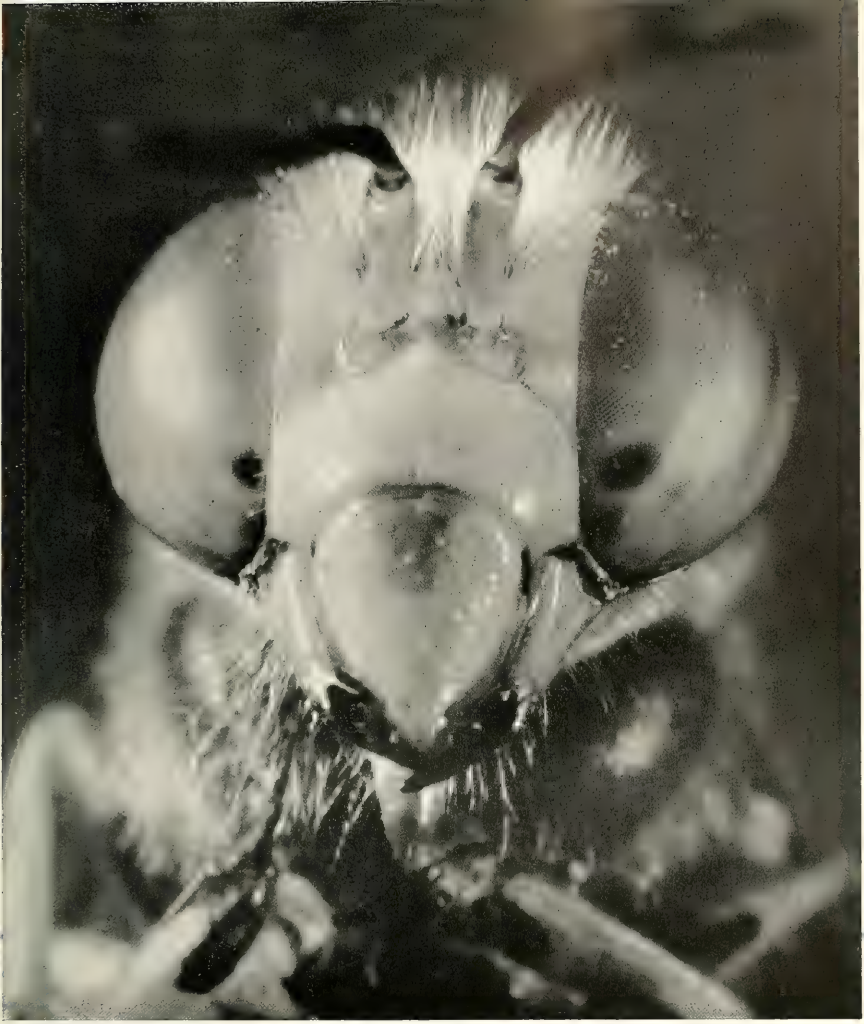


Using jaws hinged at the sides of its head, the common paper-making wasp, *Polistes pallipes*, gouges out bits of wood to chew into pulp for nest making. It produced wood-pulp paper millions of years before man. In eighteenth century Europe, an experimental book was once printed on wasp-produced paper

ON THE FACE OF IT

By Edwin Way Teale

[illegible]

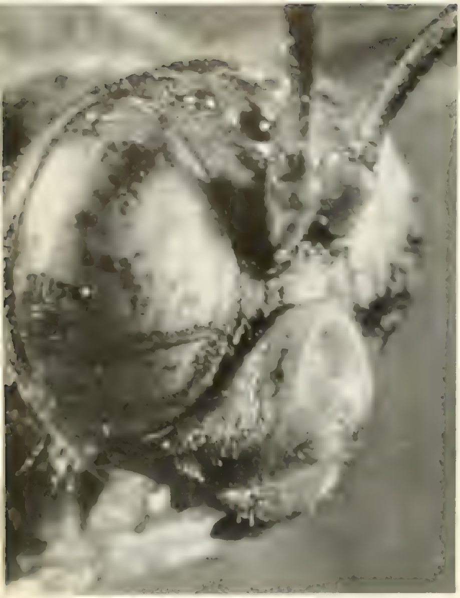


The green-banded digger wasp, *Bembex spinolae,* can be observed to burrow into the ground to lay its egg on a paralyzed fly deposited at the bottom of the tunnel. When the wasp larva emerges, it begins to feed on the fly. As this baby wasp grows, the mother brings additional flies to feed it

In an advertisement for a book which recently appeared in Natural History Magazine, the question was asked: "What Wasp is that?" My interest was aroused immediately. This simple question opens up a fascinating field for exploration. Wasps are familiar to every back yard. Yet few of us have seen the faces of these common insects. Enlarged to easily observed proportions, they present a surprising variety of countenances. All you need for an Alice-in-Wonderland expedition into the wasp world is a net for capturing the insects, a microscope or magnifying glass, and a handbook to introduce you to the insects.

As a taste of what you will see, I show you here the portraits of five common wasps. No two of these insect faces look as much alike as the faces of a Chinaman and an Indian. All mankind can be divided into five races—yellow, red, white, black, and brown. But the five wasps you see here are only a small sample of approximately 12,000 wasps found in the world. And these wasps, in turn, constitute only a fraction of the order of insects known as Hymenoptera, while the Hymenoptera form but one of about 30 orders of insects comprising a total of more than half a million different species.

Seen through the magnifying glass, the coloring

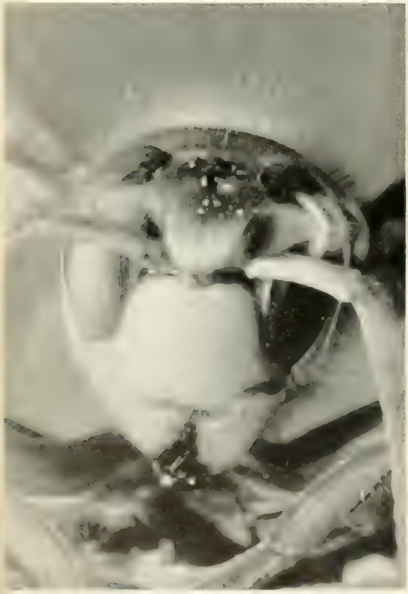


[illegible] interesting differences [illegible] scope without an exclamation of admiration and astonishment.

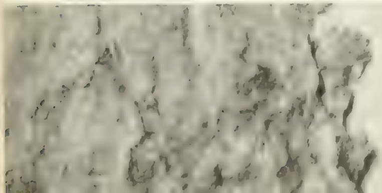
An added charm to exploring the wasp world is the [illegible] of the creatures we meet. Each has [illegible]. In the world of men [illegible] may [illegible] another may spend his life raising grain. But each wasp hews to the line of its individual customs. The strangeness of some of these customs is indicated in the captions under the portraits of these wasps.

So the question "What Wasp is that?" opens the door to a near-at-home world which holds infinite marvels for anyone who explores it.

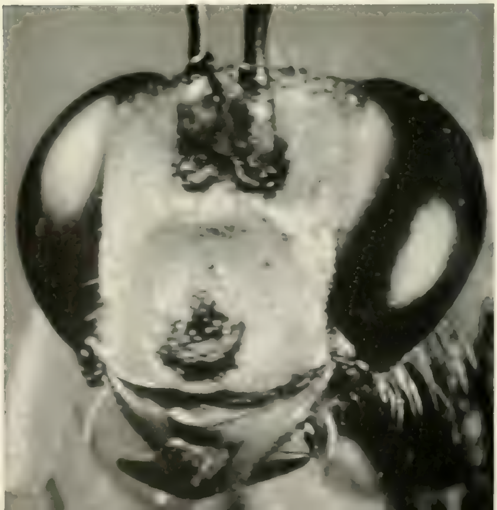
(Left, above) This wasp, which looks somewhat like an insect bulldog, is the cicada-killer, *Specius speciosus*. It stocks its burrow with paralyzed cicadas. Because its prey is heavy to carry on the wing, it often drags its burden up trees and then launches out on a slanting descent that gains ground toward the burrow



(Left) About a century ago, *Vespa crabro*, the hornet, arrived from Europe. It catches insects as big as monarch butterflies, snipping off wings and chewing up the bodies to provide "hamburgers" for the larvae in its covered-in, wood-pulp nest. Adult wasps live on nectar almost exclusively; their larvae get meat. Below is a photograph of paper from a white-faced hornet's nest



(Below) Long-horned grasshoppers fill the underground larder of this digger wasp, *Chlorion ichneumoneum*. It flies home holding its prey headfirst, like a streamlined pontoon. The powerful forked jaws of this wasp aid it in gouging out dirt while digging its burrow



CHROMIUM *continued from page 149*

from the Philippines in 1940 and 1941; slightly more was imported from Rhodesia, and nearly as much from South Africa. Nine other nations contributed the rest in 1940, with Turkey producing an important amount of high-grade ore. Chromium is certainly essential to our war effort, and the loss of the Philippine supply and that of New Caledonia, would be serious. However, African imports can probably be increased to compensate, as long as the South Atlantic routes are kept open.

Meanwhile, the American Government is rapidly increasing domestic output by an arduously pushed investigation of the nation's chromite resources. California produced some tons of chromite in the last war, and those deposits have been reopened and further explored. Other deposits in Alaska, Oregon, Washington, and Montana have been prospected, and some production has already been achieved. Some stock pile has been built up, though that work was started much too late. Probably still untouched South American deposits can, in time, be made to yield considerable quantities of higher grade chromite than is produced today. If supplies become short, economies can be effected to a certain extent in the utilization of chromium steels where the peculiar properties of strength and resistance to corrosion are not so essential.

THE LION, KING OF BEASTS

By JOHN ERIC HILL

Drawn by

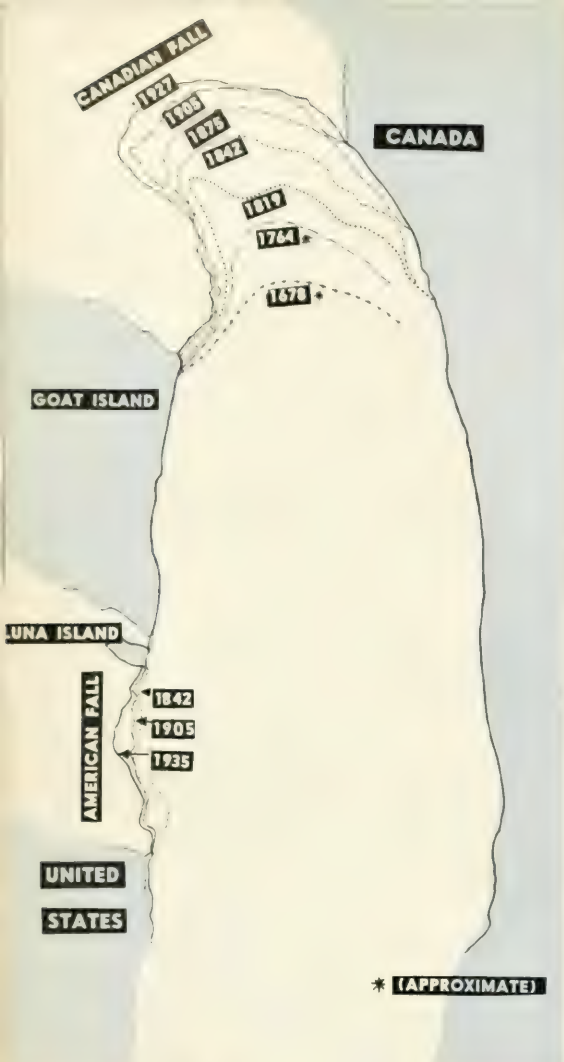
G. FREDERICK MASON

EMPERORS, kings, religious leaders, and knights have proudly borne names referring to the lion: Richard Coeur de Lion; Henry the Lion, Duke of Saxony and Bavaria; Haile Selassie of Ethiopia, the Lion of Judah; Leo, the name of thirteen popes; Leonidas (that is, lion-like), the Spartan leader at Thermopylae; Leonard (strong as a lion), and other variations have been used. The lion is the wild mammal most often mentioned in the Bible, and it is probably also the most mentioned in other literature.

To primitive man the lion was probably the most awesome animal of all, and those who first took their names from the king of beasts may thus have proclaimed themselves a terror to lesser men. The warrior who met and killed a lion was a man to be respected, perhaps the spirit of the lion was now in him.

During the Middle Ages chivalry developed. The old predaceous ways of the European peoples were mixed with and somewhat mollified by Christian influences. There were no longer lions in Europe, but the Crusaders brought back accounts from the Near East, and the traditions of the classical age were embellished with these stories. The lion was considered a most suitable emblem for a knight, for the ideal lion combined courage with most of the medieval virtues. And chivalry did not prevent a great deal of predatory behavior, as history clearly shows.

The lion gives some basis for much of the legend. Most hunters testify to the courage of the king of beasts, even against such odds as the modern rifle. More hunters have been killed by lions than by any other African game animal, but in many cases wisdom is the better part of valor and the experienced lion may seek to avoid his arch-enemy, man. A lion does not kill for "sport." He is often "sportsmanlike" in preying on the more powerful animals, while a duiker—a small antelope—may share the thicket in which he lays up.



Almost a symbol of eternity to many visitors, America's most famous waterfall has actually shifted its position nearly a quarter of a mile in 264 years and is sure to change its appearance in years to come

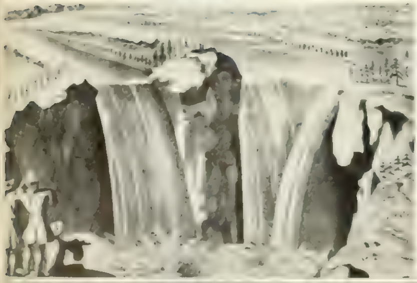
Among the phenomena of waterfalls and river gorges the Cataract of Niagara is justly regarded as holding first rank, and as standing an index in the path of time by which the immeasurable ages upon the surface of our planet may be computed. Its present position and its prospective conditions have engaged the investigations and the speculations of many philosophers. The possible consequences of its onward recession and the drainage of the upper lakes have excited the anxiety and apprehension of many. The estimated time of its recession has sprinkled grey hairs among the fresh locks of the young and blooming earth, and alarmed those who would still consider her youthful in years.—JAMES HALL, 1843

When the rain drips from the roof of your house, you are probably not aware that it is wearing away the edge of the roof over which it falls as well as actively eroding the ground below. But when millions of gallons of water pour over the edge of a waterfall it would seem certain that the edge of that fall as well as the basin into which the water plunges is going to be actively cut away. And there is every evidence that such waterfalls are worn back. In the case of Niagara Falls the evidence consists not only of the long gorge below the falls—a gorge extending for seven miles to the cliff face at Lewiston and Queenston Heights—which was cut as the falls were worn back from their original site where the river first plunged over that cliff. It also consists of the large pile of broken blocks at the foot of the American Falls, and of the large rock falls which occasionally modify the face of the falls and are topics for newspaper report.

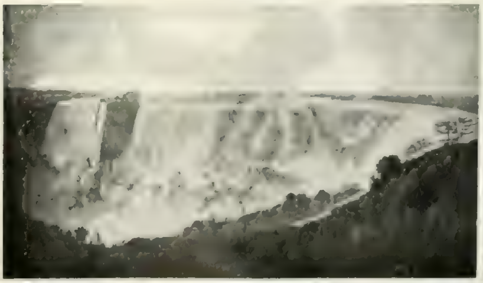
Less striking, perhaps, but more graphic in its im-

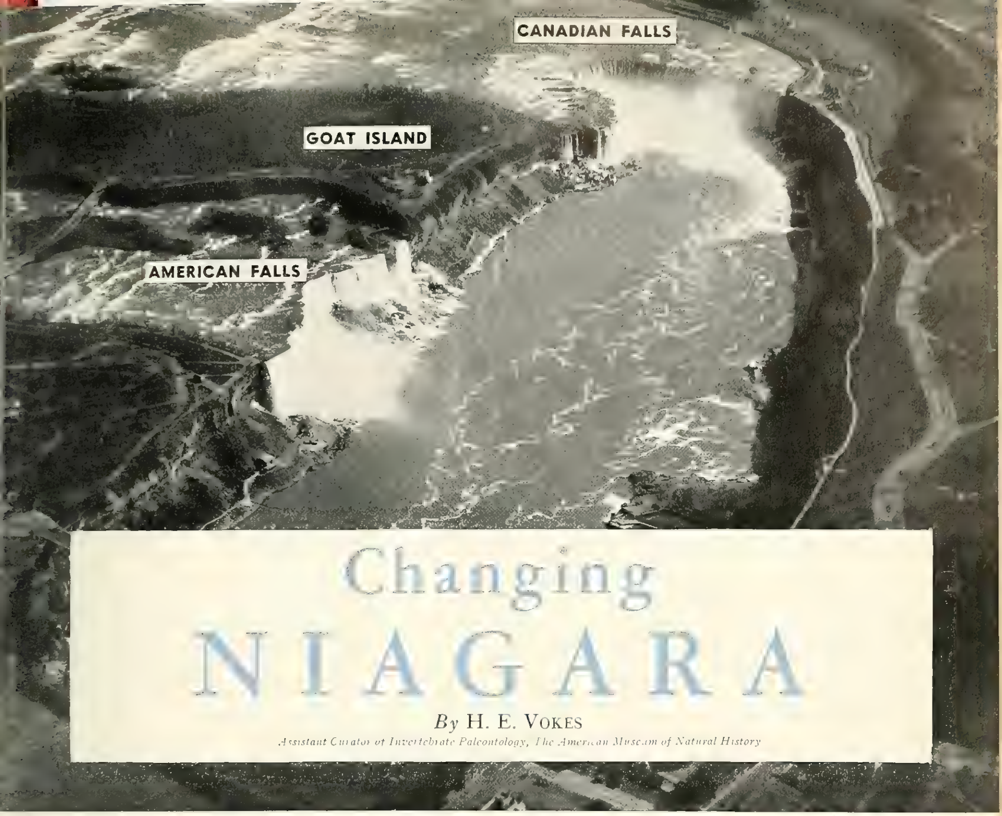
Horseshoe Fall is retreating much faster than the American fall, as shown by comparing the 1842 positions on the diagram at left. This is because more than 95% of the water goes over Horseshoe Fall. In time the Canadian branch of the river will cut back past the upper end of Goat Island and capture the water that now goes over the American Fall, leaving the latter dry

1678



1764





Changing NIAGARA

By H. E. Vokes

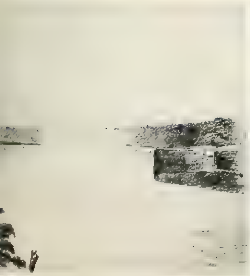
Assistant Curator of Invertebrate Paleontology, The American Museum of Natural History

Keystone View Company

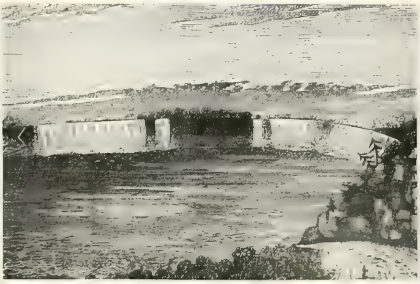
(Above) A RECENT PHOTOGRAPH, showing the whole geography of the falls area. Note the huge pile of broken rock at the foot of the American Fall which resulted from the rock fall of 1931

port is the evidence gleaned from a comparison of the crest line of the present falls with that shown by the many surveys of the crest that have been made in the past. It is interesting to note that it is exactly 100 years since the first accurate survey of the entire falls area was directed by James Hall, the famous geologist quoted above. This enables us to measure the extent to which the falls have receded during the past 100 years. Plotting the crest lines shown by the Hall survey as well as those of several of the numerous surveys made within the past century leaves no doubt that Niagara is being worn back, and at a rate that surprises most persons. It also shows clearly that the Horseshoe Fall is retreating much more rapidly than the American one. The reason for this difference in the rate of erosion is clearly understood when we realize that more than 95 per cent of the water passes over the Horseshoe Fall, while the remainder, less than five per cent, is so spread out that the deepest water at the crest of the American Fall is only three

1819



1842



1875

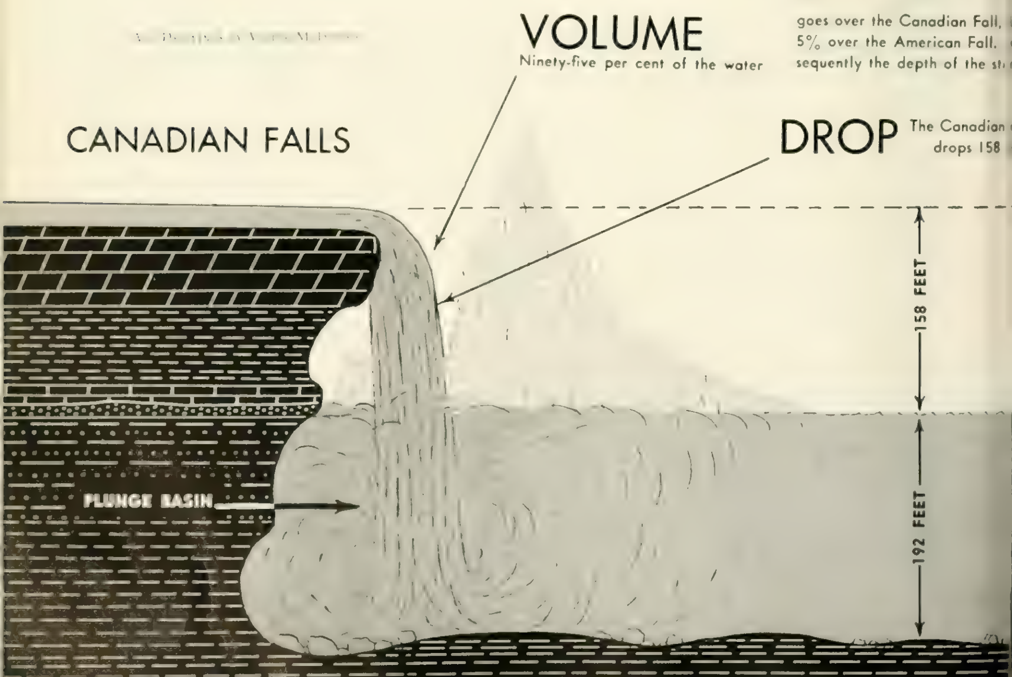
[illegible] The depth of the water in the [illegible] of the Horseshoe Fall [illegible] The "undermining" of the [illegible] at the base [illegible] The [illegible] layer, forming the bed of the river above the falls as well as the actual crest of the cataract itself, is a hard, [illegible] Lockport Dolomite. This layer is about 80 feet thick and is relatively resistant to erosion. But it is underlain by a series of soft shales and sandstones. There is a relatively thin zone of harder strata just above the water level below the Horseshoe Fall, but the beds under it, which form the wall and the bottom of the plunge basin are again of soft easily eroded rock. In other words the falls are capped by a "roof" of hard limestone overlying a whole series of soft rocks. As a result the water glides over the hard edge of the roof and falls with terrific force on the soft "ground" below, which is very quickly worn away and is scoured out by the action of the currents set up by the falling water. This rapidly undercuts the resistant "roof," encouraging it to break off as large blocks. The blocks fall into the pool where the turbulence of the water spins them around and around like a stone in the mill. Spinning in this fashion they tend to grind away the soft wall and further undercut the edge of the roof. This is the origin of the spectacular rock falls as well as of the slower, but more inexorable and constant erosion of the entire crest.

The rate at which the erosion occurs is more diffi- [illegible] In [illegible] of the American Falls the rate is relatively slow, only a slight fraction of a foot per year, a rate probably not much greater than that which would occur under normal weathering along the crest of any cliff so sharp and abrupt. The rate for the Horseshoe Fall is much faster. In that part of the fall where the water is deepest the falls apparently retreat almost six feet per year. Toward the sides and in those other parts of the crest where the water is shallower, the recession is appreciably slower, so that the average rate for the entire fall is about four and one-half feet per year. This has been [illegible] students of Niagara, notably by the late Dr. G. K. Gilbert of the United States Geological Survey and Professor J. W. W. [illegible] Survey of Canada.

Knowing this rate of recession, it would seem quite easy to calculate the age of the falls, since it is known that they began with the first fall of water over the edge of the cliff bordering Lake Ontario near Lewiston and Queenston. Such calculations were commonly made in the days before we became aware of all the [illegible] which complicate such determinations. The

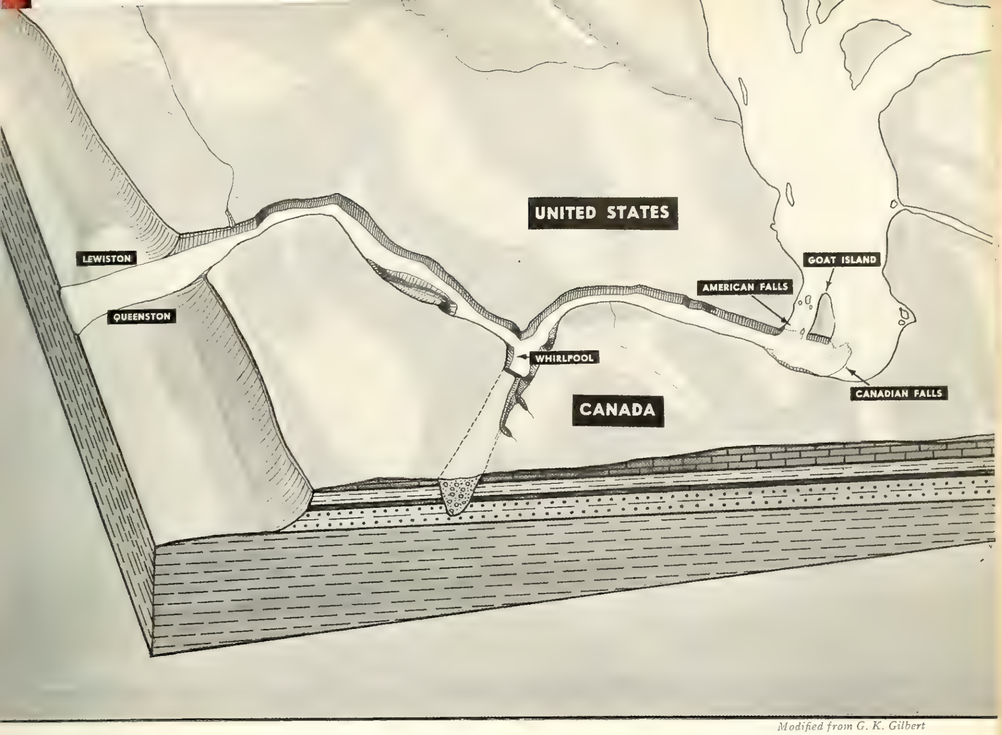
THE FALLS are due to a hard layer of rock, the Lockport Dolomite, which forms the brink. The rate at which the falls retreat is governed by the softness of the underlying layers. Swirling currents eroding these layers undermine the cap-rock, causing it to break off. Owing to the gradient of the river bed above the falls, Niagara will become higher before it becomes lower, but it will eventually degenerate into a series of cataracts as do all falls

[illegible]


CANADIAN FALLS

VOLUME
Ninety-five per cent of the water goes over the Canadian Fall,
5% over the American Fall.
sequently the depth of the st

DROP The Canadian
drops 158

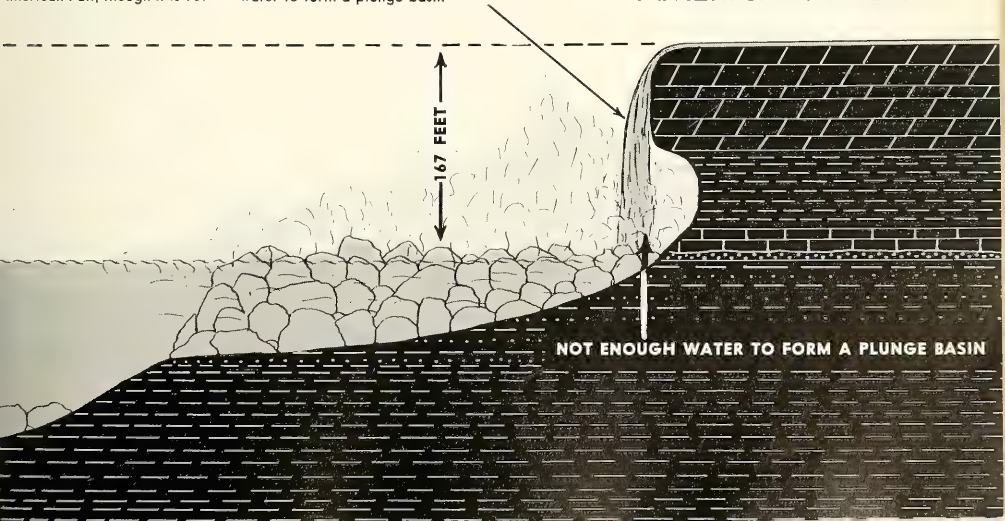

UNITED STATES
LEWISTON
QUEENSTON
GOAT ISLAND
AMERICAN FALLS
WHIRLPOOL
CANADIAN FALLS
CANADA

Modified from G. K. Gilbert

he crest of the American Fall ages only eighteen inches and hes a maximum of but three and one-half feet. On the Canadian Fall, the stream is probably 20 feet deep at the deepest parts

a plunge basin 192 feet deep. American Fall, though it is 167 feet high, does not have enough water to form a plunge basin

AMERICAN FALLS


167 FEET
NOT ENOUGH WATER TO FORM A PLUNGE BASIN

[illegible] by the history of the Great Lakes themselves. Today Niagara carries all of the water from all of the upper four of the Great Lakes [illegible]. But such has not always been the case, for there was a time when all of the drainage above Lake Erie drained out through a channel passing from Lake Huron through Lake Nipissing and down the Ottawa River. During that time Niagara carried only the water of Lake Erie and had only about [illegible] its present volume. The rate of recession would, of course, have been much slower.

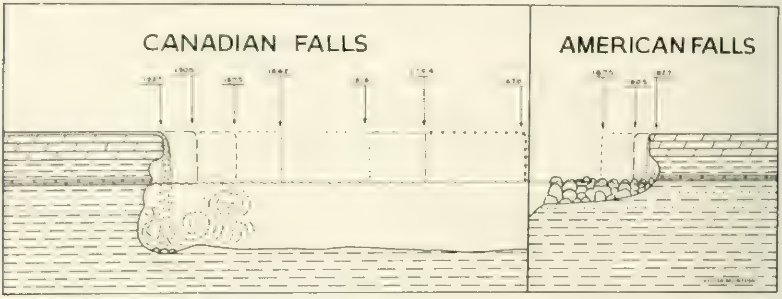
On the other hand, the river cut one section of its [illegible] channel of an older river. The hard, resistant Lockport Dolomite had already been removed from this area, so it is probable that the rate of erosion was greatly accelerated here. The section referred to includes the whirlpool and the gorge immediately above it. The old pre-Niagara River had previously cut across country to empty near St. David, Ontario.

Because of these and other complications, the period of time required for the cutting of the whole gorge cannot be accurately stated. But many tentative determinations have been made. These range all the way from 5700 to 100,000 years. The latest and most considered estimates seem to agree that Niagara Falls has been a spectacle of scenic beauty for about 20,000 to 25,000 years.

And how long will the falls continue to exist as a scenic attraction? That again is a question for speculation, and no entirely accurate estimate can be made. It is certain that the faster rate at which the Horseshoe Fall is receding will eventually cause it to cut back past the end of Goat Island and capture for itself the water which now passes over the American Fall, leaving the latter a dry monument to its present glory. It is also certain that by the time the Horseshoe Fall has reached this point it will, because of the gradient of the river bed, be some 40 to 50 feet higher than it is today.

On the other hand, the Lockport Dolomite dips toward the south, and thickens in that direction to a maximum of about 150 feet, before it passes under a softer overlying formation. As the Lockport becomes thicker it will probably be more resistant to undercutting and the rate of recession of the crest may tend to become progressively slower. Even after the crest reaches the place where the Lockport is overlain by the softer rock, the Lockport will probably continue to form the brink, for the softer rock will be easily eroded away; and the falls will then tend to become progressively lower and lower as they recede. Eventually the level of the crest will approach that of the river below the falls and there will no longer be any Niagara as we know it today. Instead there will be a tumultuous series of rapids and low cataracts dashing through gigantic blocks of tumbled stone.

It is difficult to estimate how long it will be before this will come to pass. It seems safe to suggest, however, that Niagara is only in the middle of her long and spectacular life and that tourists will revel in her beauties for thousands of years to come.



A cross section shows that since the first white man viewed it, Horseshoe Fall has cut back a distance over seven times as great as its height. The American Fall has receded but little in comparison

> But amid all these speculations Niagara still remains, the thunder of its cataract still reverberates through its chasms, and its ocean of waters still rolls on as, unknown to the white man, it rolled a thousand years ago.
>
> James Hall, 1843

VANISHING *Eden*

By MARTIN BIRNBAUM

Pages from a journal describing a voyage to the ever-fascinating isles of the South Seas, replete with shipwreck, exotic feasts, and discerning observations on Man and Nature

ALL PHOTOS BY THE AUTHOR

IT seems only yesterday that Charles Ricketts, perhaps the most cultivated man I have ever had the good fortune to know, urged me to throw over everything and sail away to the great temples submerged by fantastic jungles and the waters of the Mekong, to stand beside the monstrous figures on Easter Island, watch the blood-red sun setting over waving fronds on coral atolls, and renew our youth in the exotic company of gentle Polynesians.

Ricketts, alas, never realized these dreams; but I vowed that I would follow his advice and take a spiritual bath among the legendary isles made famous by Melville, O'Brien, and my friend Robert Flaherty.

When our boat eventually anchored in the harbor of Papeete, after a ten-day trip from San Francisco, the first native to come on board was Paré, otherwise known as Johnny Gooding, the son of the immortal Lovaina, a leading figure in O'Brien's *Mystic Isles of the South Seas.* His huge frame broke through all barriers to superintend the removal of the luggage belonging to some shipboard friends, and he condescendingly invited me to live with them beneath the leaking roof of his informal "Annexe."

This building would have been attractive had its original thatched roof not made way for an ugly one of more durable corrugated iron. It stood on a road which ran so close to the shore that at certain points it was lapped by the waters of the lagoon. Such essential comforts as doors, curtains, and mosquito nets seemed superfluous to our landlord, and one was embarrassed to find that privacy was not at all valued in Papeete. Not only our ablutions but our entire private lives were open to the gaze of prying guests who occupied adjoining bedrooms and even to promenaders on the footpath below. Strange indeed were the scenes we witnessed when candlelight lit up the bedrooms of this unique hostelry! However, you had to ignore formalities as well as wasps and huge benevolent mosquito-eating spiders if you wanted to enjoy Paré's hospitality, his luncheon parties, and his slightly salacious dancing, which was still very skillful, despite the quantities of adipose tissue which his frame supported.

TAHITI. The palm-fringed beach at Arue is of smooth black sand, volcanic in origin. Here land crabs scoot to safety when morning bathers come down to plunge in the crystal surf

[illegible] us. There were stranded jet-black Solomon Islanders [illegible] Annamites under circular, conical straw hats, and many Chinese who were shopkeepers in Papeete, mingled with half-castes of all shades. Everywhere we saw the barefooted Polynesian women with their leisurely movements, velvety brown skins, and the peculiar charm that has drawn generations of Europeans to the South Seas. Beautiful women have indeed always played an astonishing role in the history of these islands, which still remain essentially matriarchal in social organization. The native homes were built on a raised paved stone terrace called a *paepae*, and they sat there like professional beauties to be admired by passing strangers. On certain festival days they swam in the surf for the edification of the populace. If a powerful chief coveted the lovely wife of another ruler, he indulged in the quaint custom of borrowing her for a brief period. Many wars were fought over the charms of the marvelous Polynesian ladies. In the absence of brothers they inherited property and chiefly titles, as did the sovereigns of some European countries. Such chiefesses were independent of their husbands and had seats or thrones near the altar in the maraes, or sacred walled enclosures.

Shopping for breakfast

Paré did not serve meals, except for the simplest of French breakfasts, so we bought quantities of fruit to enrich that light repast. To do so we were obliged to rise before dawn and join a good-natured crowd in a barricaded market square. Exactly at sunrise, a cannonshot reverberated through Papeete, and the barriers went down. There was a mad scramble by the prospective customers for their favorite booths, and late-comers got little if anything. Choice items disappeared in a jiffy from the counters or crates, and then groups of gossiping shoppers would start leisurely for their abodes. The rainy season was just over and every road was gay with beautiful varieties of hibiscus, delicate abutilon, lively yellow allamanda, masses of bougainvillaea, and oleander, flaming cannas, hedges of coleus, lantana shrubs (which are a troublesome but handsome nuisance in the tropics) jasmine, [illegible] plants, exquisite Madonna lilies and frangipani to saturate the morning air with marvelous penetrating perfume.

Entertainment without program

Our lunches and dinners were obtainable at the French pension "Diadem," at the club known as the "Cercle Bougainville" (named after the French explorer), and at the late Lovaina's Polynesian restaurant, called the "Tiare." Now and then we would [illegible] we consumed quantities of tiny oysters seasoned with limes, fresh water shrimps, crabs, guava in coconut cream, poi, sweet potatoes, *tai oro* (grated coconuts mixed with pink shrimp fat), banana fritters and chicken in turmeric sauce. Our favorite regular meeting place was Moo Fat's noisy, hilarious Chinese rooms. Aside from getting delicious almond chicken to eat, one never knew what adventure to expect there. It was a rendezvous of the sailors from the French fleet, and the singing mariners were usually accompanied by amorous Tahitian belles who were good dancing partners. In the course of a meal a jealous suitor [illegible] Hollywood director would give his eyeteeth to see. Broken bottles would fly about in the ensuing scuffle, skulls of rivals were cracked, faces were scratched, blood flowed freely, women screamed, police whistles blew, and scattering Orientals vanished magically from the scene. But when the pandemonium ceased, the denizens of the district quietly emerged from their hiding places and wended their way nonchalantly to Papeete's unique cinema palace, known as the "Theatre Bambois," a place of amusement even noisier than Moo Fat's.

Here the audience came and went ceaselessly. A lusty announcer explained the action to the natives and he had to shout loudly to be heard above the musicians, the laughing children, dozens of snarling, barking dogs, and the tireless food hawkers stationed just beyond the entrance. Situations which we accept calmly arouse strange emotions and reactions among Tahitians, for their social conventions differ violently from ours. They would, for example, scream hysterically with laughter during a sentimental scene in which Mary Pickford's youthful swain would lean over a rustic fence to kiss her,—instead of rubbing noses. The hall did a thriving business and was always crowded, unless there was some free rival attraction, such as a public ball given by some rich American yacht owner, who would invite all Papeete to a huge party. Such gatherings were extremely democratic. We could dance with royal princesses of doubtful reputation, who looked like pretty New

York Jewesses and were actually descended from Salmon, an English Jew, who had married into King Pomare's family. Some women came in European ball gowns, while others wore cotton Mother Hubbards. There were men in dinner jackets and white gloves, but some had no collars. A few waltzed in patent leathers, others were barefooted. Whites, Negroes, half-castes, and Polynesians, aristocrats and prostitutes,—all mixed freely. Apparently no social distinctions were observed, and I now regret that I never had the patience or fortitude to remain to see one of these strange bacchanalian parties in its last early morning stages.

Our daily routine called for a glorious morning swim at Arue on the palm-fringed beach of hard, smooth black volcanic sand, over which the land crabs scooted when we ran to dive into the pounding breakers of crystal-clear water. After a siesta, we might go to Point Venus, where in 1769 Captain Cook had observed the transit of that planet, or walk through the jungles along a moist path alive with black-and-white "mourning" butterflies to a secluded, romantic glen where a primitive stone relief, about four feet in width, lay hidden under wild taro leaves and maidenhair. It may be related in some mysterious and still unexplained way to the sculptures on Easter Island. Its phallic nature was obvious and showed a complete nude figure with outstretched arms. Natives who knew of its existence feared to approach it. To them it was taboo—like King Pomare's tomb, a visit to which, they said, cursed the unwary by afflicting them with leprosy.

Waterfall

On another tramp we were rewarded by a fine view of the famous Fautaua waterfall on the opposite rim of the plateau. Like a silver ribbon it fell in an unbroken leap of about 600 feet into a limpid pool below. Here mothers washed their babes a few hours after they gave birth to them, and later taught the children to become remarkable swimmers. In this and other localities, we collected and compared many specimens of pretty land snails (Partula) differing slightly in shape and color but obviously descended from one parent stock.[1]

It so happened that our stay in Papeete coincided with the Fourteenth of July celebrations, and the French administrator arranged competitions of communal dancing and himene[2] singing for prizes. If only he could have decreed that correct ancient native costumes be worn by the participants! During the day French sailors raced against stalwart native oarsmen, and Queen Marao gave an informal reception to dancers and victorious Tahitian athletes.

The queen was a colossal woman, with an unmistakable personality. She wore goggles, a masculine straw hat, and the usual Mother Hubbard, but made of black silk. With one of her daughters, she received her patriotic subjects in the back yard, and I noted with surprise that the nonchalant young men who brought offerings of squealing pigs and clusters of *feis*, or wild bananas, did not remove their hats and even spat in the royal presence. The queen's father was the Englishman Salmon, mentioned above, and her title to the throne was derived from King Pomare, her deceased husband, who had divorced her. Gossips said that the royal couple lived together only one day and that the king, having secured a divorce, celebrated his freedom by incessantly singing the popular tune, *E Maururu Avau* ("I am so Happy"). His family history and many legends surrounding Tahitian royalty are told in a rare privately published book,[3] written, surprisingly enough by the famous Henry Adams, author of *The Education of Henry Adams*, after legends related to him by the queen and an old chiefess.

When the patriotic festivities ended, we were free to start on a circuit of the island in a rickety antique buggy. It was a hazardous but scenically attractive trip. Tahiti is mountainous and volcanic and is divided into many narrow valleys. Although snakes do not exist in this paradise, its Creator might be suspected of having some grudge against the islanders, for there are other more sinister invisible dangers. While bathing, care has to be exercised, for coral scratches may cause blood poisoning, sometimes with serious results. There are venomous sea creatures which one must avoid. Leprosy and especially repulsive forms of elephantiasis are common scourges. Over and over again we came upon men and women who were almost helpless, disfigured wrecks, with gigantic organs or limbs. The victims, in cases not too far advanced, can be cured by operation or by moving to cool northern countries. Meanwhile, the sufferers go about doing their daily chores uncomplainingly. Loathsome skin diseases are also an ever-present brooding danger which take their toll of the natives.

In the course of this expedition we stopped at Tautira, where Robert Louis Stevenson had lived; and from time to time we visited some artists and authors who were seeking to escape from the sophistication of white civilization, as Gauguin had done. Chief among these men were Robert Keable, author of *Numerous Treasure*, and "Borneo" Smith, a venturesome traveler who tried to transform a tract

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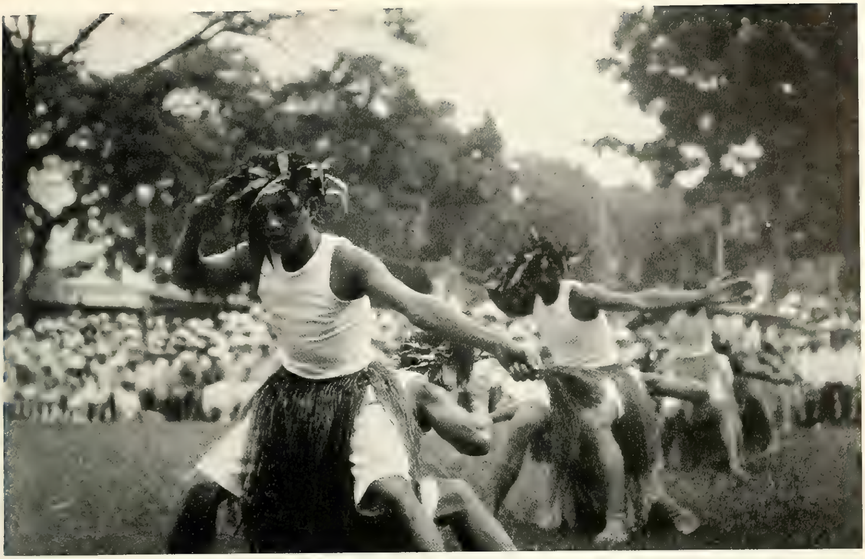
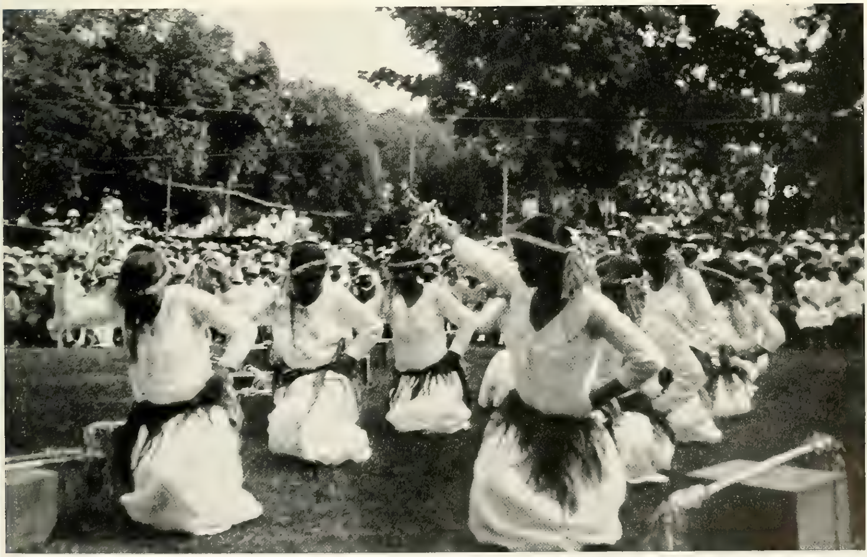
[1] The effects of geographic distribution and isolation on this genus are beautifully shown on a large relief map of Tahiti in a special exhibit at the American Museum of Natural History.

[2] Though not hymns, the songs thus designated in pidgin English have borrowed the name from our word.

[3] *The Memoirs of Arii Taimai e Marama of Eimeo Teriirere of Tooarai Teriinui of Tahiti Tauraatua i Amo* (Paris: 1901)



(Above and below) COMMUNAL DANCING on the Fourteenth of July, national holiday of French-governed Tahiti. Athletic boys and white-clad girls enter song and dance competitions arranged by the administration



(Left) LIKE A SILVER RIBBON, the Fautaua waterfall leaps approximately 600 feet down the craggy volcanic slope. In a clear pool at the foot of this cascade, mothers wash their babies a few hours after birth and later teach them to become remarkable swimmers. The funnel from which the falls spring into space is plainly visible

(Left) NEAR Robert Louis Stevenson's Tautira lies this view of the Vaitapiha River. Many artists and writers have found refuge in Tahiti from the uncongenial atmosphere of civilization. The French painter Paul Gauguin is one of the most celebrated of these, but there have been numerous lesser lights. Of our contemporaries, Nordhoff and Hall, the popular fiction team, are perhaps the best known Tahitian expatriates. In times gone by this mountainous island produced native types of great physical beauty, whose simple and happy life has since suffered under the conflicting attitudes of the white man

(Below, right) LANDING WHARF on Moorea. While fraternizing with the natives of this island near Tahiti, the author witnessed an impromptu moonlight dance of surpassing primitive beauty. But such spontaneous self-expression is becoming increasingly rare throughout the South Seas, owing to the inhibiting effect of white civilization and the resulting loss of many elements of the native culture. The white man has drained much color and variety from this world of waving palms, and given little in return

(Below) A TRANQUIL RIVER VALLEY near the coast of Tahiti, showing typical mist-shrouded volcanic hills in the background. The productive coastal region of this French possession yields coconuts, bananas, and oranges, as well as sugar cane, vanilla, and other tropical fruits

of land into a rank impenetrable jungle. O'Brien had already left the islands never to return, because his famous books, *Mystic Isles of the South Seas, White Shadows in the South Seas,* and *Atolls of the Sun,* were not favorites among Tahitians. Other settlers were Nordhoff and Hall, who have since become celebrated as authors of the books dealing with the mutineers on the *Bounty*. In an article which appeared in *The Atlantic Monthly*, Hall, who had married a charming native girl and was already raising a family, gave many convincing reasons for abandoning New England to contemplate existence among these South Sea Islanders.

Before meddling Christians disturbed them and introduced new diseases, the islands were compared to paradise! What have we given these people in exchange for the ancient ceremonious existence and the ancestral Polynesian code which we destroyed? Fed on the fiction that economic development would bring many advantages and blessings, the natives receive as their compensation for white injustices only another war! How can we expect them to believe in the beauties of conflicting faiths, sects, and conventions, which have brought such bitter fruits in their train? One particular experience of mine gave rise to many such tangled reflections regarding the benefits of our much vaunted civilization. One evening on the island of Moorea I was playing my violin on the beach for some native friends. After I stopped playing, a young, scantily clad dancer leapt into the air and executed one of the loveliest moonlit hulas, accompanied only by the lapping waves and the rhythmic humming and hand-beating of his friends. It was a glorious incident in a dream-like setting and gave me a hint of the passions beneath the stolid exterior of the natives. Suddenly a man's shadow was seen in the palm grove and the dancer stopped as if stricken, the boys scattered hastily, and there was no more music that night. The "shadow" was a missionary whom they feared like a plague! Let no one who has read Somerset Maugham's *Rain* assume that Mr. Davidson is merely the figment of a novelist's imagination!

When we left these gentle people they smothered us with leis of flowers, seeds or shells, and rubbed noses with us affectionately. Knowing that I loved flowers they had given me a native name, "Motoe" (*Mos'oi* in Samoan), after the ilangilang, the tree of perfume fame. As we steamed from the harbor to sail for Fiji and thence to Samoa, the crowd on shore sang their mournful himenes, and I felt wistfully that I was leaving real friends whom I might never see again.

Samoa

Flaherty had warned me not to expect too much of Samoa after the colorful vegetation of Tahiti, and when we entered the deep, narrow, protected harbor of Pago Pago the somber mountains, to which rain clouds clung, seemed to shut out the sunlight.

Unless a visitor is a guest at an American official's home, he is practically obliged to take shelter under the roof of the notorious little hotel made famous by Somerset Maugham in his brilliant story, *Rain*. Its miserable balcony faces the dominating peak called the "Rainmaker," and it is conveniently near to the groups of native houses, which have ovoid hemispherical thatched roofs supported by trunks of trees. We saw no abodes as beautiful as the chief's on the island of Bau in Fiji, but the owners took great pride in these homes, and in their precious heirlooms. They refused most generous offers for old fishhooks of bone, mother-of-pearl or tortoise shell, and strange hooked knives with handles held together by brass.

Naturally we paid our respects to the American governor and the lesser officials. One night a young lieutenant, armed with a sharp three-pronged stick, took us on a centipede hunt. These dangerous myriapods are from six to eight inches long and very poisonous. You probably will not find it in the books, but a curious thing was pointed out by the lieutenant who was with me. "You will see something remarkable happen every time we kill one of these," he said. Then he demonstrated. Each time we attacked one of the myriapods, a second one rushed out of the grass and attacked the forked stick. I was told that this invariably occurred. Large scorpions are also fairly common. Birds are rare, and I never saw any on a long ride along the road running close to the beautiful shore, white with breaking rollers. We passed great numbers of the widely distributed monarch butterfly, but a moving vehicle is not a good vantage point for making notes on natural history. Nor could we linger in the villages of Leone and Hunli to study house-building and the making of tapa, for we were afraid of missing the boat due to sail for Apia.

My main reason for coming to Samoa was to visit the village of Safune and meet the native actors who played the roles in Flaherty's *Moana*. Ever since I had seen the uncut version of that beautiful film, I longed to absorb the famous *Fa'a* Samoan spirit in their company. Fialalei, the charming English-speaking interpreter who ably assisted Flaherty, had already met me at Apia, and she told me where to look for her brother, Arthur Yandell, on the island of Savaii, where the motion pictures were made. It is the

[illegible]

[illegible] that it is still found, but its habit of building its nest [illegible]

[illegible]

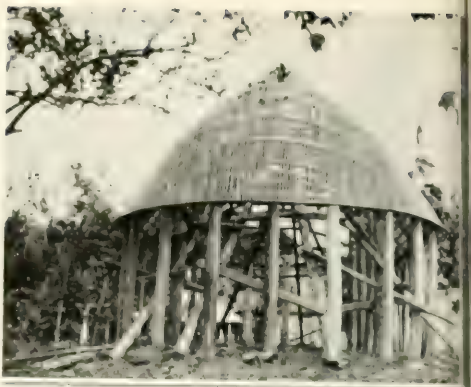
[illegible] ceremony, that peculiar feature of Samoan communal life. It took place in the fine house of crafty old Moana (not Flaherty's hero but the man who played the role of the benign father).

We sat politely cross-legged on mats in a circle around the chief with our backs against wooden pillars supporting the roof. A taupo, or ceremonial hostess of the village, who is always the lovely virgin daughter of a chief, made the kava, assisted by her attendants. They chewed small pieces of the root of *Piper methysticum* after carefully washing their mouths. A young chieftain, who is the guardian of the taupo and responsible for her virtue and safety, sat near the young girls. Heaven only knows what exalted station in life they thought I graced, and while my fictitious titles were recited aloud by the chief's spokesman or *tulafale*—a tall, magnificent embodiment of his race—, the chewed roots were mixed with water and prepared for drinking.

The ceremony can be compared to tea drinking in Japan. As their guest, I was the first one served, and nothing could excel the grace with which the enchanting taupo handed the coconut cup to me. Fortunately I remembered Flaherty's picture of such a scene and before I tasted the libation I called out [illegible] and showed my respect for their gods by first pouring a few drops on the ground. My gesture evidently met with the surprised approval of the assembly. The beverage looks like water in which putty had been dissolved. I had already been introduced to it and rather enjoyed its slightly acrid taste—something like bitter almonds seasoned with pepper. I knew that it would revive and refresh me after my long fatiguing walk, although too much of it will make your legs unsteady. After the cup had passed the round of all those present, the ceremony was repeated, and complimentary speeches were in order. In responding to the *tulafale's* toast, I told them about the great distance I had come and described the skyscrapers of New York, besides thanking them for the pleasure that Robert Flaherty's picture was giving vast audiences throughout the white man's world.

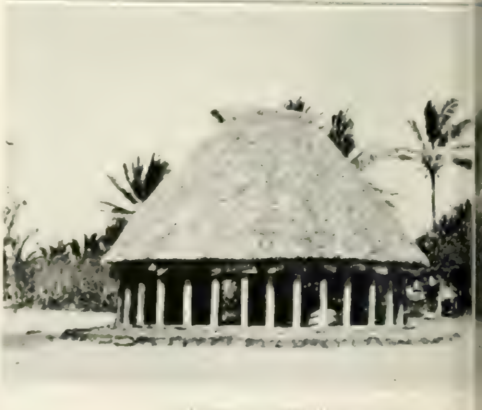
On returning to Apia, I learned to my consternation that a slight influenza epidemic was threatening that district as well as Pago Pago. This would mean quarantine and serious delays, and the sole opportunity to avoid these was to catch the steamer *Ventura*, leaving the American harbor for Hawaii, before the health restrictions would become more drastic.

The only available boat was an eight ton trading vessel, the rudder of which, so it was whispered, was in poor condition. We had no lifeboat or barometer. Threatening black banks of clouds on the horizon seemed to block our way when we started, and trailing wisps of smoke lay close to the surface of the bay; but we were told to have no fears of dirty weather because our finely tattooed captain Billy Hicks and his crew of two boys knew the treacherous waters and every inch of reef and coastline. There were no cabins so we made room on the deck among the oilcans and bags of cocoa for some mattresses loaned to us by considerate English friends, who evi-

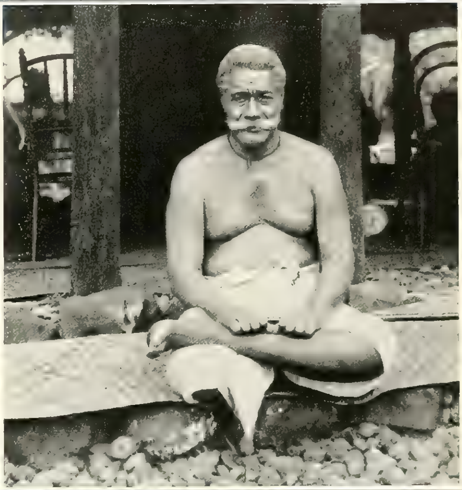


(Above) A SAMOAN native house under construction

(Below) OPEN WALLS characterize the finished dwelling



(Above) A RESTORATION of the house of John La Farge near Apia, Samoa. The artist shared quarters with Henry Adams, the renowned New England traveler and author



(Right) THE SAMOAN HIGH CHIEF who gave a reception for the author. He sits in front of his house in characteristic pose, left foot over the right knee

FATHER DUMAS, the priest at whose mission house the author stayed after he had been shipwrecked in the district of Aleipata. The three boys are fine examples of the Samoan physique

[illegible]
it began to rain.

[illegible] Hicks [illegible] set. As the boat sank to wallow in the trough of the sea, then rose and lurched from side to side, every movable thing on the deck of his vessel slid about, and the stationary items changed their slant to a terrifying [illegible] against Nature's powerful forces. Bareheaded, de[illegible] and [illegible], I was holding fast to the [illegible] With my eyes [illegible] to keep out the stinging spray, I felt precariously alone in the abysmal darkness, and in one of those strange moments which come to us all when our lives are at stake, I reviewed my entire career from early childhood. The force and rush of the mighty winds increased, and when I opened my eyes for an instant, I could see that we were dangerously near to the rocky shore. My fellow passengers were already too seasick to realize fully our peril, and to my dismay I saw that our captain and boys were trembling with an attack of the "flu." Finally, Hicks, a victim of fatigue and bodily misery, handed the wheel over to one of the boys and fell exhausted into a hammock which hung over the open hatchway.

There was no respite for him or for us. The hissing torrents of rain poured from the sky and the angry all-enveloping sea kept breaking over the helpless [illegible] vessel. It was a miracle that I was not swept away, but I knew that if I let go, I would find myself sprawling on the deck or lost in the swirling inky waters, so I held on tenaciously, hooked as it were to the mast. I shall never understand why we were not swamped in that stupendous storm. It tore violently at everything and shrieked exultingly while the hammering surf drowned the calls and warnings of my prostrate friends, who were avoiding the shifting oilcans on the flooded slippery deck. Hicks, glaring madly at the elements, simply had to arouse himself and take up the hurricane's challenge. He called on all his reserve energy to take the wheel once more at this perilous juncture.

The *Tiafou* was taking in water through her seams. The leakage gained on us, although our sick boys kept baling and pumping all through the black night. Would Hicks lose control of the laboring vessel? He cursed and yelled as each wave made the groaning boat quiver from end to end. The strain was almost unendurable and his powers were taxed to the utmost. At last, he shouted to tell me that we [illegible] reached the [illegible] of Aleipata at the eastern end of the island of Upolu, a rich copra trading center; but it was no comfort to hear him burst out with an unprintable oath that we would never reach Pago Pago. Evidently the experienced old mariner did not think the boat could weather the gale much longer.

To the leeward, his restless eye had pierced the obscurity and he could distinguish a chain of volcanic rocks, against which the rest of us expected momentarily to be dashed. They stood like sentinels near the entrance to the lagoon at a point known as "The Cauldron," where the boiling, raging current rushed through the break in the great coral reef. Our slim chance was to find this opening, and now the captain's remarkable familiarity with the rock and reef [illegible] stood him and all of us in good stead. Desperate but calm, he skillfully guided the vibrating *Tiafou* on the crest of a huge wave at the only possible moment, and while I braced myself against the mast, we were literally whirled into the sheltered and comparatively calm lagoon. The trembling *Tiafou* reeled but did not quite collapse. As soon as Hicks was sure that he had succeeded, he threw our anchor overboard, not knowing that the rotten ropes would break, letting us flounder and drift aimlessly about till dawn. Children discovered our benumbed party practically beached on the sands near the mission house of Father Dumas later that morning. We were safe, but stranded in Aleipata.

A native welcome

After we were made comfortable, the chiefs of the neighboring villages paid us visits and offered us food, shelter, and many opportunities to study the daily lives of our hosts. The men are the warriors, the hunters of wild pigs, the fishermen, the netmakers and the builders of houses; they also carved canoes and constructed boats.

The womenfolk were by no means household drudges, although they looked after the home and the kitchen. They wove baskets and plaited fans. They ornamented tapa cloth with designs cut on blocks of wood. They made vegetable dyes as well as oils and perfumes for the hair and skin. Lava-lavas and ornaments of shells or feathers were among the special products of their labors. Above all, they wove the celebrated mats of pandanus fiber. Months of careful hand-weaving were necessary to produce a really fine flexible mat worthy of a chief, and such mats became the most highly prized of all heirlooms. They formed the treasured items of the dowry of a princess, or the shrouds for the body of a deceased royal personage. A grateful chief might bestow one on the family of a skillful boat builder, architect, or tattooer, just as a European ruler might honor a citizen with a distinguished service medal. Some of these mats enjoyed local fame and were given explanatory names such as, "The mat finished in Saliusi" or "The mat woven on the deck of a vessel." Titles pass with their ownership as they do with jeweled crowns. Pitched battles have been fought for the possession of these symbols, and the legends surrounding them are told in the sacred books, which no Samoan dares handle irreverently.

Shortly after our arrival we were honored with a reception at the house of the chief, who was a relative of the great Mata'afa. He was a fine figure of a man, and had his skin been lighter, he would pass for a prosperous Wall Street financier. In the old days he would have been regarded as a demigod and would be carried in a litter by his people whenever he paid visits, for all land that his feet trod upon became his property. Speaking English hesitatingly, he received us very graciously, surrounded by his family and his *tulafale* or spokesman, served us with refreshments, and showed us the truly wonderful royal mats woven so finely that they looked like flexible brown linen. At this ceremony, men in place of a gentle taupo, made the *kava,* and the ritual was not as impressive as in the village of Safune. Nor were any of the feasts at Aleipata as lavish, for a recent storm had driven fish far from the coast and had ruined the breadfruit and banana crops, besides destroying poultry and cattle. They were expecting the swarming of the strange sea worm called the palolo (*Eunice viridis Gray*), which rises to the surface of the sea in unbelievable millions on certain nights of the year. Then the natives are kept busy collecting the slimy fragile annelids, in every available receptacle. In the meanwhile the villagers went hungry, and we, as American "millionaires," were expected to show our material appreciation of their hospitality by presenting each group with kegs of dried beef,—gifts which we bought from a white trader, who had a native wife and half-caste children. It was fortunate that the ancient *malaga* custom is frowned upon by the existing foreign laws to which the Samoans now submit. In the old days entire villages would roam about the islands paying ceremonious visits en masse to other villages. A *malaga* was like the descent of a cloud of hungry locusts on the unwilling hosts. The cost of the obligatory entertainment practically put the visited village into bankruptcy, and the only recourse or revenge was an unwelcome return visit.

A boat was leaving Apia in a few days for Fiji, and there we might catch another ocean liner sailing from Suva directly to Hawaii. So we were obliged to leave Aleipata on another little trading vessel, and we stopped at Fiji only to change steamers.

Farewell

At noon on the third day of the voyage north, we were treated to the last thrill when we passed Canton Island,—as perfect a coral atoll as one could wish to see. Far from any other land, it was almost a perfect circle of glistening sand, covering the work of the coral polyps. It was still a very young island, for only a few graceful palms swayed over the sheet of sparkling green water which it enclosed, and it was outlined by foaming white breakers. As it disappeared on the horizon, it served as a perfect symbol of the lovely regions we were leaving behind us. Here was an Eden still uninhabited, and the gentle Polynesians who might have discovered and settled it a century ago were vanishing. For months I had steeped myself in their views of life, and never again would I be scornful or contemptuous of the so-called "savage." Melancholy and alone on the deck of the *Niagara,* I sat recalling the scenes I had only recently witnessed in just such an environment, treasuring the still vivid impressions which had raised doubts in my mind on the wisdom of encouraging the march of white man's civilization. The mood of elation in which I started my voyages vanished, for I realized that I was stupidly returning to a collapsing world and the trap of modern industrialism from which I thought I had escaped. Already I knew that further disillusionment would only start me off again in pursuit of some new elusive goal. In the meanwhile I was transported in reverie to a feast where my handsome brown friends sat around their chief, a gentleman whose high rank no one could mistake although he wore only a pareu. Could a European ruler be recognized merely by his dignified bearing if seen dressed in nothing but a bathing suit?

Everybody greeted me with a cheerful "Ia ora na," and when I sailed away they sang their mournful himene, which roughly translated means:

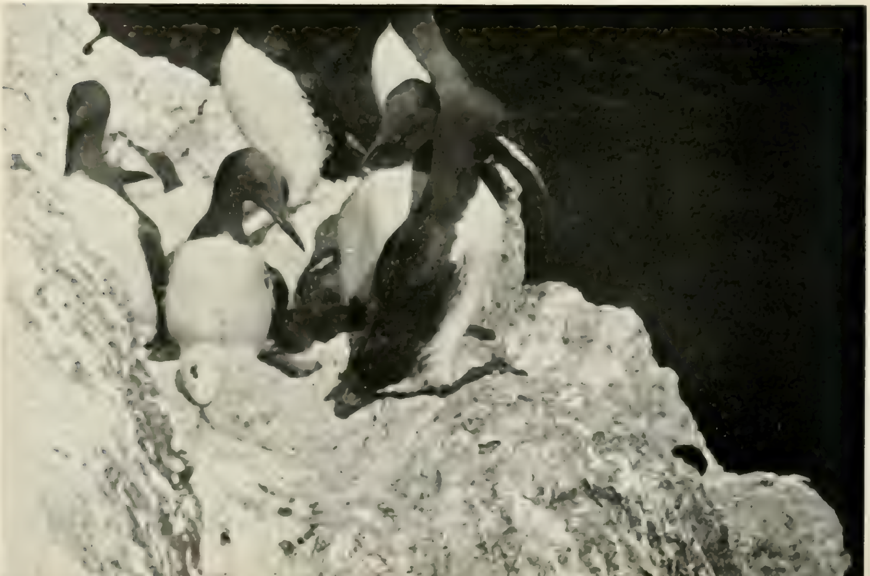
Farewell, my friends who leave to sail on the ship for America; do not forget Samoa, our land, and think of us, O passengers.

This article will soon be published in book form along with a number of other essays narrating the author's tropical travels, under the title *Vanishing Eden* (William E. Rudge's Sons, Publishers).

(*Above*) GALLERIES overlooking the sea on the face of Oregon's Cape Lookout provide a rather perilous "nursery" for the California murres which spend the first weeks of their life here

Californi

THE EGGS have brown splotches on a background ranging from grayish-white to bright blue. This detached colony of about 30 birds on an accessible ledge showed a high loss of eggs and decrease in numbers. By July 2, only about twelve birds remained and only four chicks and two eggs were in evidence. Depredations by gulls and disturbance by visitors were chiefly accountable. The birds engage in little fighting aside from mild sparring between close neighbors accompanied by raucous screams. The bird on the right has just returned with a small fish for its chick



MURRES

By WILLIAM GRAF

ALL PHOTOGRAPHS BY THE AUTHOR

CAPE LOOKOUT, jutting three miles out into the Pacific on the coast of northern Oregon, is the home of several nesting colonies of California murres. Almost the entire south side of the cape is a sheer cliff, rising nearly 1000 feet at the highest point. Being practically inaccessible, most of the cliff face cannot be viewed except from a boat from below. The difficulty of photographing these birds proved rewarding, for it resulted in a fascinating record of their brooding, feeding, and social habits, as well as some of the dangers that confront them.

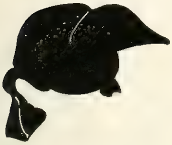
Probably one of the worst dangers the murres have to contend with is waste oil discharged by ships. Many of the birds were observed to have dirty, oil-smeared feathers, and dead murres with oil-matted feathers are common on the Oregon beaches.

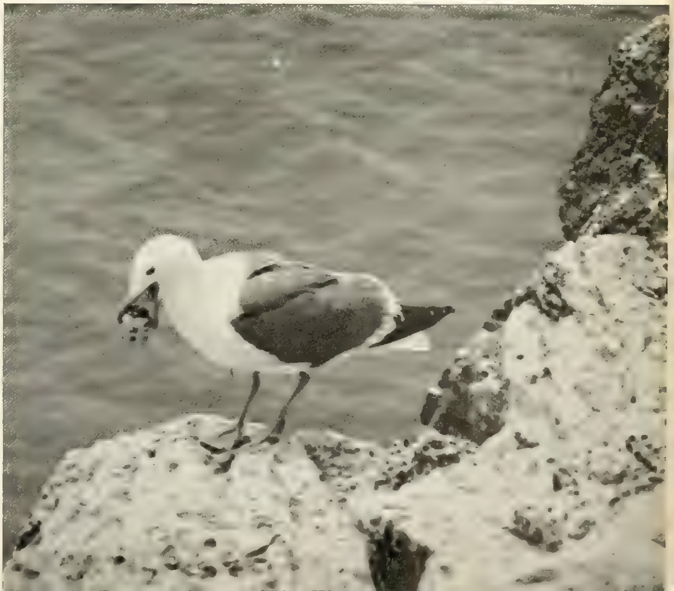
The older murres, while stupid and indifferent in defending their eggs, showed considerable intelligence and anxiety in watching over their chicks. When a youngster wandered too near the perilous brink, the old bird would crowd in between and if necessary forcibly stop its progress by shoving it back with the bill. In one instance, a very young and still weak chick tried to cross a steep face of rock to another ledge after the old bird had been frightened away. When it began slipping down toward the brink of the ledge, its cries brought prompt response from the old bird. The latter worked its way out on the steep slope and got beneath the chick and tried to push it up. The footing was too precarious and the chick too weak to take advantage of this help. Finally the old bird also began to slip downward and had to abandon the chick, which tumbled over the edge into the sea.

Aside from the egg-stealing gulls, about the only other natural enemies of the murres are the occasional duck hawks (Peale's falcon) which often nest on the lofty cliffs near large sea bird colonies.

Most of Cape Lookout's rugged terrain is covered with a dense stand of hemlock and spruce and an almost impenetrable, jungle-like undergrowth of shrubs and vines. To the windward a colony of murres can be detected for at least a half mile by its odor. At close quarters on a hot day and in the company of swarms of biting flies, the vicinity is anything but pleasant.

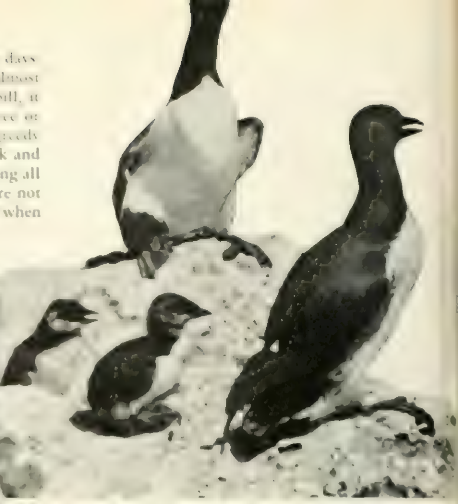
The colony pictured numbered between 800 and 1000 birds. To judge from the bedlam of noise and the incoming and outgoing birds, there are probably several other large colonies on ledges where they cannot be seen because of the overhanging form of the cliff. Farallon cormorants were common, nesting to a lesser extent than the murres, on the more inaccessible ledges.

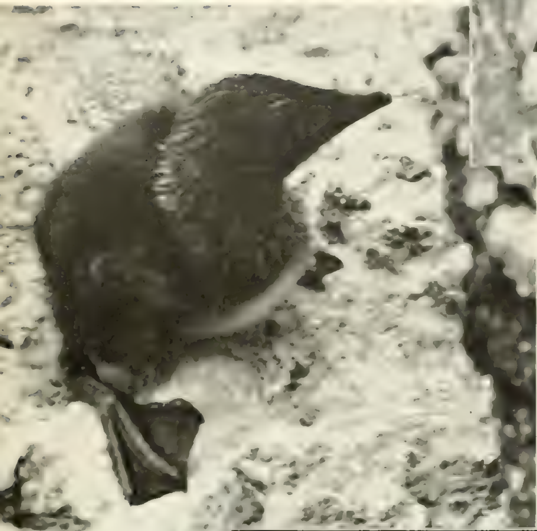




ONE OR TWO CALIFORNIA GULLS are always patrolling the edge of the colony for an unguarded egg. Lacking easy opportunities, a gull sometimes brazenly lands near a nesting group and, after a short sparring bout which is rather half-hearted on the part of the owner, literally snatches the egg from under the murre. The egg is carried only a short distance and then broken by dropping on the rocks. As often as not the egg rolls over the brink and is lost in the sea. In any case the gull's bill is rather poorly suited to taking up liquid, and much of the egg is wasted

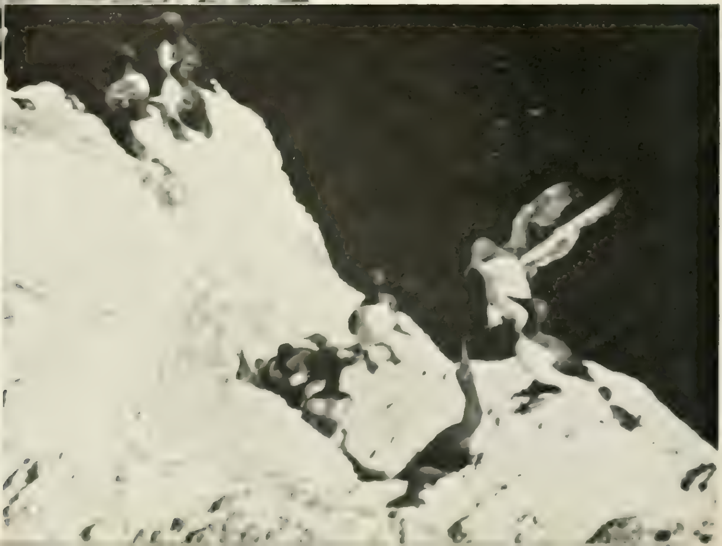
(Below) A TYPICAL YOUNGSTER of about four to six days. Though barely able to toddle, it could swallow a fish almost as long as itself. Receiving the fish crosswise in the bill, it would turn it quickly and swallow it headfirst in three or four gulps. Presumably to prevent food snatching by greedy neighbors, the old bird would crowd close to the chick and protect it with partially spread wings, effectively blocking all efforts to photograph the procedure. Strange chicks are not tolerated by neighbors, who deliver a sharp pecking when they wander from their own nest spot





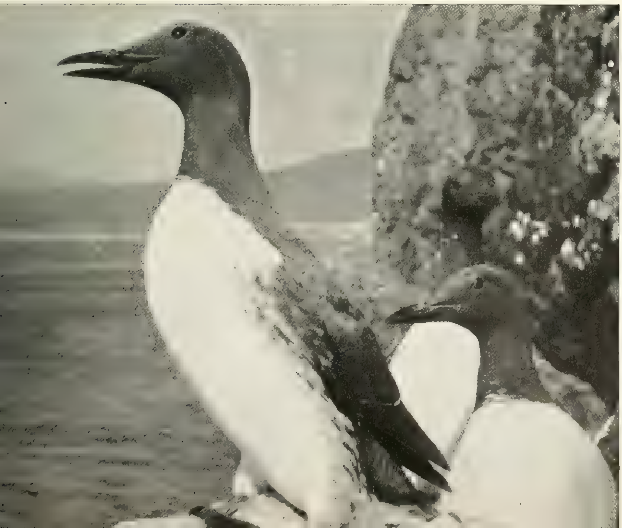
UNCERTAIN CHICKS three or four weeks old *(above)* sometimes fall off the cliff accidentally and were observed in the water below the nesting ledge. All were being led straight out to sea. They ducked and swam with ease; and when a chick dived, the old bird always dived with it. Most of the colony's young of this size made no voluntary attempt to take to the sea

(Below) INCOMING MURRES travel full speed until within only 100 feet or less of the ledge. Then they set their wings and swoop upwards, back-pedaling only a few feet from the landing spot, and land as lightly as sparrows. A few were seen to misjudge their landing and tumble over and over among the rocks, but this may have been due to the photographer's presence



A VERTICAL BANK. Though not given to fancy flying, murres can execute sharp turns when frightened. This one came up to land but became frightened, banked sharply, and made a neat right angle turn

PROBABLY A NESTING PAIR. There is no way of identifying the sexes by outward appearance. Murres are highly social. Like this pair, they prefer to remain close to others of their kind, often in close contact



PORTRAIT OF A CALIFORNIA MURRE. This one shows dark feathers along the sides, probably a characteristic of not fully matured birds. Others which were assumed to have "come of age" were immaculately white clear up under the wing. At other times, waste oil from ships marred the clean beauty of their "starched shirtfronts." The matting of their feathers with oil is a man-made menace to these birds

Seven League Boots for Your Camera

By Charles H. Coles

[illegible]

THE [illegible] photographs of this type must [illegible] that the animals will appear in the [illegible] itself in the picture. Just as the naturalist uses field glasses to see his game, [illegible] the cameraman be equipped to magnify the image of distant game.

Long lenses

The development of special lenses to make distant objects larger so that they appear closer to the camera than they actually are is an interesting chapter in the history of photography. When special design was young, cameras were fitted with lenses of long focal length to achieve this magnification. The Auto-Graflex camera was equipped with long bellows to take lenses of this sort. As in all Graflex cameras, the photographer had the advantage of focusing [illegible] the image on a ground glass screen right up to the moment of exposure. However, a lens with a focal length of ten or twelve inches and a diameter of two and one-half or three inches, projecting from the front of the body, gave the camera a good bit of weight and caused it to be front-heavy. In spite of this defect, a naturalist's Graflex was later made that would take even longer and heavier lenses; and, notwithstanding the bulk and ponderousness of these cameras and lenses, marvelous work was done with them by indefatigable workers.

Telephoto lenses

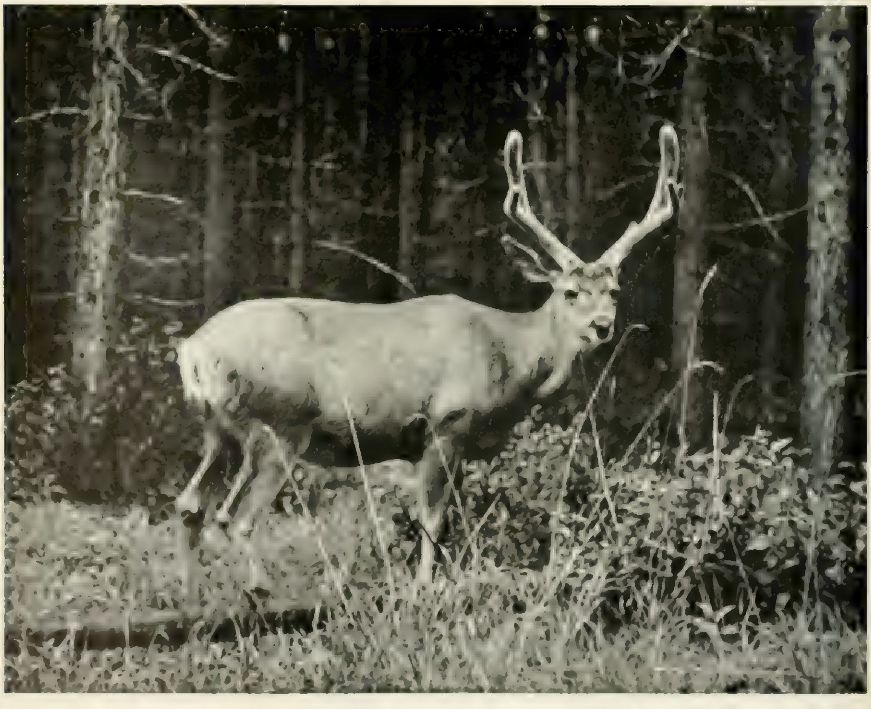
The cameraman's load was lightened considerably when the fast telephoto lens was designed. This lens has a second or rear magnifying component built into it which increased the size of the image cast by the front lens. The whole unit was much smaller and lighter. For the same degree of telescopic effect the lens did not have to be as long as formerly, and though the lens might properly be marked as a seventeen-inch lens, its actual length was somewhat less. This eliminated the need for a huge bellows extension.

Some of these lenses were built to have an adjustable magnification; but because of their lack of critical sharpness, they lost favor and few are seen today. The telephotos now in common use are the fixed magnification type. The sizes ordinarily used by Graflex owners are the eleven-inch or seventeen-inch, f:4.5 or f:5.6.

[illegible]

Mule deer in the velvet, Jasper National Park; photographed with an 11-inch telephoto lens at a distance of 100 feet. This reproduction is an enlargement from a small section of the negative

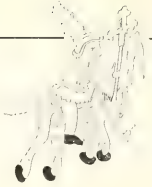
[illegible]



HORSE GODS *of* Guatemala

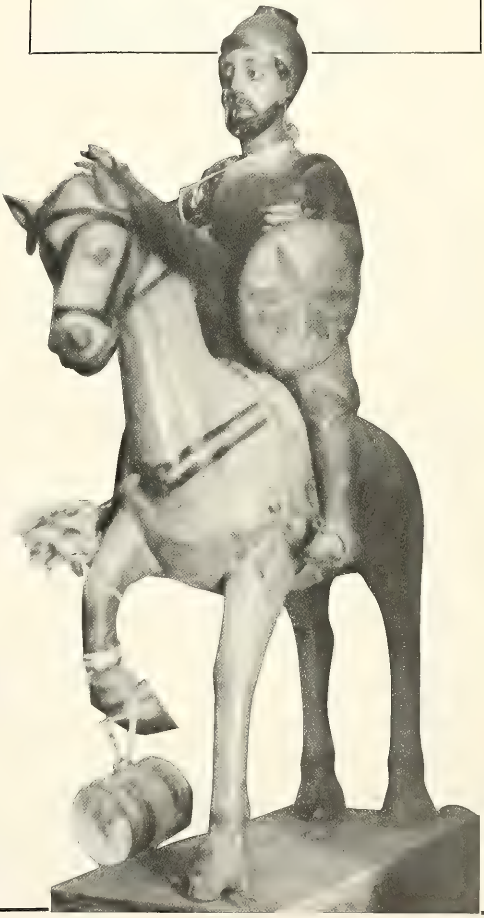
America's first invasion by men riding on horses was a terrifying event that has cast its shadows even into Indian religious practices of modern times

By DOROTHY REYNOLDS



From the *Codex Telleriano Remensis*

The Spanish conquistador on his mount, depicted above by an Indian artist of the time, became a symbol not only of worldly but also of supernatural authority



A central figure in almost every church in Guatemala, the horse of Santiago is treated with scarcely less veneration than its rider and is only one of several symbolic horses reflecting the emotional impact of a distant event

The first horses in America were those brought over by the Spanish *conquistadores.* And yet, when early Franciscan missionaries reached Lake Petén in the heart of the jungles of tropical Guatemala, they discovered an island upon which lived a tribe of Indians who worshipped the image of a white charger as the most sacred of all their idols. The animal, known as Tzimin-Chac, the Tapir God of Thunder and Lightning, was carved as if rearing up on its haunches, with the front legs straightened out to support its partly raised body. Upon seeing it, one of the Spanish priests, Friar Juan de Orbita, in a frenzy of religious zeal, broke it into a dozen pieces and scattered them over the floor of the temple. Thereupon, the Indians, very angry at the white men for coming into their land and demolishing their most sacred possession, set up a great cry of "Kill them! Kill them! They have destroyed our thunder god!" and rushed at the intruders with such fury that the Spaniards were barely able to get away alive, with the islanders at their heels, chasing them to the water's edge and pelting them with stones and arrows as long as the boat was within reach.

The story of how that horse became the idol of so isolated a tribe is a curious one. Shortly after Cortez completed the conquest of Mexico, he made a trip southward into Central America for the purpose of exploring that region and finding out whether or not it, too, was worth subjugating. While he was passing through the Petén district, his own horse, a fine white charger, became injured or exhausted, so he left it with the Indians, giving them strict orders to treat [illegible] tion, whereupon the terrified Indians made what amends they could by carving a stone image of it to set up in their temple.

[illegible] ural one to the natives of Petén, for they were already accustomed to worshipping the tapir, which is still found in various parts of Central America. This [illegible] in a sort of short trunk. Indeed, when archaeologists first found tapirs carved on ancient monuments in Central America without knowing anything about the animal—they thought they were elephants and began an excited attempt to link up Maya civilization [illegible]

As a deity the tapir was supposed to preside over storms and lightning.

The Indians at first thought that the deafening [illegible] from the horses rather than from the weapons carried by their riders. Hence they associated these new animals with their own "lightning beast." Even today the hand-woven shawls and blouses of the Indian women of the Guatemalan Highlands are frequently decorated with both tapirs and horses.

Though there is no record that the image of the horse god was set up again on the island in Lake Petén after its destruction by the Spaniards, various other horse deities still exist in Guatemala. The most pop- [illegible] Conquest, in which the villagers, mounted on horses, dramatize the coming of the Spaniards. Another horse that is sometimes deified is the mount of Santiago, patron saint of Spain and also of Guatemala. A statue of the mounted saint is a central figure in almost every church, and the horse is treated with scarcely less veneration than its rider. It is the patron of four-legged animals and is credited with many miracles in restoring horses and mules to health.

But perhaps the strangest ceremony is performed on Saint Thomas' Day at the village of Chichicastenango. At that time the little figure of a white horse carrying a rider dressed like a Spanish *conquistador* with a chain of old coins about his neck is first paraded round and round the town. Then one of the Indian men dances with him in his arms, after which a rope pulley is erected between the ground and the church spire. To this rope the horse and rider are fastened, and by means of it they are kept riding up and down, all day long and far into the night. At intervals, the little figure is removed from the pulley and the Indians pay five cents each for the privilege of dancing with him in their arms and giving him messages to take aloft. Sometimes fireworks are fastened to the horse and set off as he rises.

Various attempts have been made to explain the origin and significance of this curious *santo*, who is certainly not included in the calendar of Christian saints. The most probable theory is that he carries man's wishes up to the Sun God. Before the Spaniards came, the Mayas used a monkey for this purpose, but the horse could run more swiftly, so he was given the task. Very likely the little horse and rider are also connected with Alvarado, the conqueror of Guatemala, for he too came mounted on a horse carrying thunder and lightning in his gun. It is said that because of his extraordinary powers and his fiery red beard and hair, he was given the title Tonatiu, The Sun.

Inhabitants of the isolated village of San Pablo on the shores of Lake Atitlán showed me a small stone idol which they insisted represented Alvarado. One of them had picked it up in a cornfield, where figurines of this sort often used to be scattered broadcast to insure a bountiful harvest. It was a little head, about an inch and a half long, with distinctly Caucasian features and a headdress resembling the casques worn by Spanish soldiers at the time of the conquest.

Though such a deification seems strange at first thought, a man connected with both sun and rain might well be considered god-like, since these two elements are essential to the production of a good crop of corn.

When the Franciscan missionaries devoutly destroyed the image of Cortez' white charger, they did not realize that their violent effort to stamp out veneration of horse deities would have so little success. Centuries later the descendants of the same Indians who had worshipped the white horse still preserve in their superstitions traces of that long-past event which so terrified their ancestors—the invasion of their country by Spaniards mounted on horses and carrying death-dealing guns.

SHAWLS WORN in Guatemala frequently display the design of the large tapir, an animal originally believed to control storms and lightning. Because the Spanish horsemen carried guns, the horse borrowed some of the powers of the "lightning beast"

(Below) A PRIMITIVE VILLAGE on the shores of Lake Atitlán. Here small idols representing the Spanish conqueror Alvarado, identified with sun and rain, used to be scattered in the fields to insure a good crop

YOUR NEW BOOKS

WESTERN APACHE INDIANS • MYTH OF THE NEGRO PAST
THE JOHNSONS AT PARADISE • JOHN STEINBECK • BALI
THE PIGEON • CACTI • WEATHER AND AVIATION • TREES

THE MYTH OF THE NEGRO PAST

by Melville J. Herskovits

[illegible]

IN [illegible] West African heritage, and the evidence which Doctor Herskovits brings to the contrary is not, on the whole, convincing.

According to my experience, the purest African culture patterns of the present-day Western Hemisphere are to be found [illegible] Bush Negroes (to whom I had the privilege of introducing Doctor Herskovits on an expedition in 1928) and to a lesser extent among the Haitians, the Negroes of Cuba, Martinique, and Guadeloupe. Aside from the Bush Negroes of Dutch Guiana, whose history is unique, African survivals appear to be most pronounced in the Latin countries of this hemisphere and least pronounced in those dominated by Anglo-Saxons. For this reason, Louisiana, where French and Spanish traditions still remain, is the last locality where one can point with any degree of certainty to African survivals here.

I cannot agree that spirituals and jazz resemble aboriginal African music, or that secret fraternal societies are necessarily of African derivation as their counterparts are to be found among the whites and Indians. Belief in spirits and to some extent witchcraft does survive, but so does it among certain white people where contact with the Negro has been at a minimum. But, unquestionably, spiritual practice with West African flavor is to be found in parts of Louisiana even at the present time. The maternal family system which Doctor Herskovits points to as further proof of African survival is open to question because economic competition in the South and elsewhere discriminates against male Negro labor, and makes it easier for [illegible] the breadwinner.

Although I cannot agree that Doctor Herskovits has proved his hypothesis, *The* [illegible] collected information which the professional anthropologist will find most interesting and useful.

In areas devoid of racial persecution, like the jungles of Dutch Guiana, the Negro [illegible] arts and crafts. He could certainly serve a more useful purpose in this country than he is permitted to at the present time.

MORTON C. KAHN

THE PIGEON

by Wendell Mitchell Levi

R. L. Bryan, Columbia, S. C., $1[illegible]

WE feel that the [illegible] of this book to the readers of NATURAL HISTORY Magazine should be preceded by a call to attention! For NATURAL HISTORY does not often have the privilege of calling the attention of its clientele to so notable a publication. Listen, therefore, while Mr. Levi tells us of the pigeon as friend, ally and co-laborer, companion in sport, source of occupation, laboratory assistant, and means of support.

[illegible] the rock pigeon [illegible] is the ancestor of the domestic pigeon and its many breeds and varieties is still the prevailing opinion. [illegible] so large a measure of freedom with a corresponding degree of domesticity. Migration, mating, nesting, behavior, variation, and inheritance can, therefore, be studied more effectively with the pigeon than with any other bird. As pigeons are so closely associated with man, Mr. Levi very properly opens his subject with an attractive chapter on the relationship of pigeon and man (pp. 1-15). The pigeon's part in art, religion, and literature; the history of war heroes; the companionship of pigeons are presented here. Then we at once plunge into a study of breeds and varieties (pp. 16-153). These 137 pages treat of the very heart of practical pigeon lore. They are illustrated by 340 photographs, most of them from living individuals. Accompanied by a statement of date and place, they obviously are invaluable to the pigeon breeder.

"Anatomy" (pp. 154-173), "Physiology" (pp. 174-207), "Genetics—Variation and Inheritance" (pp. 208-251), "Behavior" (pp. 264-275), and "Practical Breeding" (pp. 250-263) all contain material of scientific interest and are particularly important for the ornithologist.

In "Diseases—and their Control" (pp. 279-333), "Feeds and Feeding" (pp. 334-384), "Commercial Squab Production" and "The Pigeon Fancy" (pp. 416-440) we again return to the wants of the pigeon raiser.

The book is well-made, and the numbering of the 1190 paragraphs greatly facilitates reference. We wish that the illustrations were also numbered. Finally, we say, own this book or at least read it.

F. M. CHAPMAN

SEA OF CORTEZ

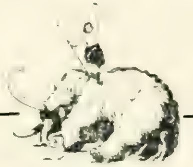
by John Steinbeck and Edward F. Ricketts

Viking, $5.00

THIS remarkable book is an account of a remarkable expedition to a remarkable region, the Gulf of Lower California, called by the writers by the more historic and picturesque name, "The Sea of Cortez."

The book is remarkable because it includes two contrasting presentations of the same theme. The first half of the book embodies a vivid narrative of the voyage and expeditionary work, by a famous novelist.

The Most Amazing Story in the World!



HOW MAN BECAME A GIANT

By M. Ilin & E. Segal

[illegible] calls it, "The best book in this [illegible]

[illegible] years of publishing

J. B. LIPPINCOTT COMPANY
East Washington Square, Philadelphia

The second half is a scientific account of the important results of the voyage.

Each author, being expert in his line, presents his theme in masterly fashion from his particular viewpoint. Yet it soon becomes evident to the reader that the novelist and philosopher is also a naturalist at heart, while the scientist betrays keen philosophic and vivid descriptive powers. The fact that a novelist and zoologist could go on a voyage together in a small boat and work with sympathetic understanding is a demonstration of their essential community of thought and mutual intellectual respect.

In the first half of this volume, John Steinbeck pictures skillfully the casual events and exciting moments of the voyage. He takes part in the collecting and portrays the habits of the marine shore fauna with keen observation and colorful characterization, interpolated with philosophic comments.

In the second half of the book, under the prosaic title of "Phyletic Catalogue," Edward F. Ricketts describes in detail the greater part of the 550 species, mostly invertebrates, collected by the expedition. He states that possibly ten per cent of these may be new to science. This feature of the work is so well arranged and so clear in the presentation of a little-known littoral fauna, that it is bound to be of inestimable value to all marine zoologists. The valuable summary, presented in his Introduction, contains important information of ecological factors of this isolated biological region, while the series of color plates, drawings, and photographs is splendidly reproduced and forms a valuable adjunct to the use of the volume by students of West Coast invertebrates.

Roy Waldo Miner.

THE SOCIAL ORGANIZATION OF THE WESTERN APACHE

- - - - - - by Grenville Goodwin

University of Chicago Press, $4.50

THIS book on the Western Apache is not merely one of the best accounts of an Indian tribe; it is unfortunately the last work of a young man of unusual talents. Grenville Goodwin began the study of the Apache when about 23 years of age and at his death ten years later left not only the manuscript for this book but notes planning several additional volumes. The reader who wishes to know the plain facts of Indian life will be the richer intellectually for having read this book. For example:

"Formerly, the greatest achievement in life that a woman could hope for was to marry a good man, have children, excel in woman's work, be wealthy through her own efforts and those of her husband, have good sons-in-law, and sometimes possess and practice minor ceremonies. The two highest attainments for a man were to become a powerful and influential shaman or a great hunter, warrior, and leader. These two aims were seldom reached by a single individual, as the first called for imagination, a certain mystic quality, and ability to lead and influence people spiritually, and the second required an innate gift for leadership and an ability to excel in hunting, raiding, war, and speechmaking.

"Modern objectives in life have not changed as much for women as they have for men. The young man now idealizes the cowboy and sometimes the shaman, and the day may come when he will wish to be a member of the elected council of his people."

The author's insights, spread over the pages of the book, were secured by mastering Apache speech and spending long periods of time with his Indian friends. Yet this is not a sentimental book, just a clearly-written, factual account.

Clark Wissler.

FOUR YEARS IN PARADISE

- - - - - - - - - - - by Osa Johnson

Lippincott, $3.50

FOUR short years taken from the adventurous life of Mr. and Mrs. Martin Johnson make up the tale of this book. They were four very full years and tell of a dream come true.

On a previous trip into northern Kenya Colony, the Johnsons had been introduced to a lake with most picturesque surroundings, far removed from the routes of the big game hunters. In this place the animals had roamed unmolested, were numerous and exceedingly tame. The Johnsons named the spot "Lake Paradise" and resolved to return at a future time for the purpose of taking pictures of these animals in their native haunts. They wished to bring back to civilization a record of the habits of the big game while it was still possible, before the intrusion of white man forced the creatures to change their mode of life. Back in America they interested influential persons and a most elaborate equipment was assembled.

Returning to Africa the Johnsons immediately proceeded to Lake Paradise and there built a home for themselves. Interesting parts of the book tell how they changed their little section of the wilderness into most comfortable abode, not only in building a house for living quarters but also extensive laboratories for the developing of their films, an electric plant, workshops, storehouses, and flower and vegetable gardens.

Using Lake Paradise for a base, the Johnsons made many safaris onto the neighboring plains, following the game as it made its migrations during the rainy season.

That their enterprise was a tremendous success may be vouched for by the many thousands of persons who have witnessed the remarkable films that were brought back. The public is most fortunate in that the Johnsons were not only outstanding photographers but that they were also capable of writing of their experience in such an enjoyable and entertaining way. The book is both interesting and readable and can be recommended not only to a person interested in natural history but to anyone who enjoys easy, entertaining reading. As might be expected, the book is profusely illustrated with some of the Johnsons' best pictures.

T. Donald Carter.

Continued on page 184

"May th' hielands aye breed guid whisky an' guid men!"
"It's the flavour"
TEACHERS HIGHLAND CREAM
86 PROOF
TEACHER'S
Perfection of Blended SCOTCH WHISKY

In shipping Teacher's Highland Cream to America, these good Scotsmen share with us one of their country's finest and most typically Scottish products.

Made since 1830 by Wm. Teacher & Sons, Ltd., Glasgow

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[illegible]

[illegible]

an inch square, or even less.

Why carry around such a bulky camera? [illegible] eliminate needless drudgery. This leads to the use of the miniature camera [illegible] of the image on the negative remains the same. No detail is lost. The only precaution is to make sure that the tiny [illegible] finder solves this problem.

[illegible]

Now the system can be carried even further. If we find a film with exceedingly fine grain, we can use a smaller film and in consequence be even farther away from the animal and still fill the whole picture area. The fine-grain film is yours for the asking: it's name is Kodachrome. Practically grainless in structure, Kodachrome makes possible the recording of exceedingly fine detail. The smaller film is of course the 16 mm. motion-picture film. Here is how the system works out:

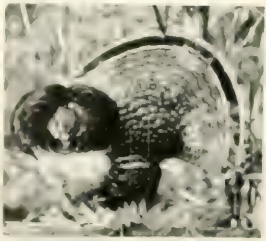
A motion-picture camera is adapted to take an eleven-inch telephoto lens. Between the lens of the film, some form of reflex focusing is introduced, so that the image cast by the lens may be studied and [illegible] on the ground glass is examined with a magnifying eyepiece to adjust the focus perfectly. The ground glass also shows the field that will be included, so that the subject can be accurately placed in the picture. When these adjustments have been made, the focusing reflex device is withdrawn and the scene is filmed.

The lens, because of its length, requires a special support. Without this it might "droop" enough to pull out of line. The camera must be set on a sturdy tripod to avoid even the slightest vibration, which might spoil the picture.

The advantage of the motion-picture camera in this type of work, besides the tiny film it uses, is that you may choose [illegible] in the strip of film [illegible]

Enlarged six times, this photograph of a rocky mountain ewe is the reward for the cameraman who is equipped with an 11-inch telephoto lens, and 3¼ x 4¼ film

THE COVER THIS MONTH



The picture on the cover of this issue is a most unusual photograph of a different subject, the ruffed grouse in courtship display. It is the work of Mr. Cleveland P. Grant who is to be commended for his patience in securing such an interesting picture.

The courtship display, with the tail and the neck-tufts spread fanwise, is exhibited by the males, probably only in the presence of the females as was the case when this photograph was taken, when it may follow a drumming performance. During the display, the male shakes his head from side to side with such vigor that the rush of air through the neck feathers is audible nine feet away.

In the drumming performance, the male stands more erect and drops his tail to help brace himself on the log. He then snaps the wings rapidly forward and upward, first in three or four single beats, then in a crescendo of faster strokes, ending in a whirring roll in which the moving wings appear only as a blur. The sound thus produced is not made by the wings beating against each other, as was once believed, but by the percussion against the air and perhaps the vibration of the wing-quills.

The ruffed grouse is known locally by different names among which that of "partridge" in the north and "pheasant" in the south are most familiar. Actually it is neither.

SEVEN LEAGUE BOOTS FOR YOUR CAMERA

Continued from page 1[illegible]2

One step more

At the American Museum we have carried the operation one step further. The 16 mm. transparency has been enlarged by photographing it with a Leica equipped with extension tubes. By photographing it on Kodachrome, the color of the original was preserved, and a magnification of three and one-half times was achieved to make the 16 mm. frame fill a 35 mm. slide. The result, while not critically sharp, was pleasing and natural in appearance, and the final size of the image was the same as if a 40-inch telephoto lens had been used on a miniature camera! That is a rare magnification even for modern photography.

LETTERS

Continued from page 131

SIRS:

. . . It is one of the most interesting publications that comes to my desk.

The President of a large
life insurance company.

* * *

SIRS:

. . . Your magazine covers certainly mark an epoch in publishing, and the birds and animals,—especially those which the rank-and-file thousands of us can never see, either alive or stuffed,—appeal both to the artist and the student and lover of animal life.

The little "Woods Pussy" [November cover] is doubtless familiar to many of us, but the combination of patience, good luck, and high artistry are an inspiration to any animal photographer. . . .

NELLIE B. PENDERGAST.
Duluth, Minn.

* * *

SIRS:

I enclose $3.00 in money-order remittance for the renewal of my subscription, which is due shortly.

After one year, I find that the Magazine is quite as interesting and as well done as when I began. . . . What I wish to say is that the covers are still superb examples of the photographic art, in color relation and in composition, the contents are as varied and as well illustrated as ever, and the criticisms are as impartial as before. I now look forward to your magazine in a new sense, that of a reminder that there are still some who work for the advancement of the sciences and the arts. It is a stabilizing force in these times.

DELMAR NORDQUIST.
Mattoon, Ill.

LETTERS

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 184

1. It melts only at high temperatures; it reacts neither to acids nor bases; and you can't open your eyes on a city street without seeing it. What is it?

2. In which of the following U. S. Army equipment is chromium used?

(a) Uniforms
(b) Rifle stocks
(c) Hobnails

3. Niagara Falls will get higher before it gets lower.

True........ False........

4. When Japan overran the Philippines, we lost $\frac{3}{4}$, $\frac{1}{2}$, or $\frac{1}{4}$ of our chromium imports?

5. What insect once provided the paper on which a book was printed?

6. If you perished in the northwestern wilderness, wolves would devour your body.

True .... False........

7. The Canadian Fall of Niagara will someday capture all the water of the American Fall, leaving it a dry monument to its former glory.

True........ False........

8. North American timber wolves attack man.

True... .... False........

9. The wild mammal most frequently mentioned in the Bible is the

(a) Hare
(b) Lion
(c) Wolf

10. Chromium's chief virtue in steel alloys is to make them

(a) Harder
(b) Softer
(c) Chemically resistant

Natural History
ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration—Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

BALI

[illegible]

[illegible] Mr. Hiss's book [illegible] of Bali [illegible] types and activities which everyone who [illegible]

[illegible] of Bali, has all the charm of the familiar [illegible] Bali will recognize, if not the actual per- [illegible] and young girls, just exactly like them, in [illegible] that the photographs are so very good and flattered by their response to the familiar, [illegible] have been to Bali, whether for three days [illegible] tion not given—which is no reproach to [illegible]

MARGARET MEAD.

TREES OF THE EASTERN UNITED STATES AND CANADA

by William M. Harlow

[illegible]

DOCTOR HARLOW [illegible] Professor of Wood Technology [illegible] New York State College of Forestry, has planned this as a field book, and it is just [illegible] It contains nontechnical keys for the identification of the native and also the most common introduced trees of the area treated. [illegible] excellent and helpful photographs, more than a dozen of which are in natural color. Unfortunately two of the latter, facing [illegible]

[illegible] general appearance, leaves, flowers, fruit, twigs, bark, habitat, distribution, and remarks. Under remarks the author has included considerable woodcraft and folklore of the various trees.

[illegible] that "yellow-wood" is compound on page [illegible]

[illegible]

WHAT KINDA CACTUS IZZAT?

[illegible]

WHEN [illegible] I was prejudiced against it by the Milt Gross title. But after I dipped into it, I was intrigued by the clever drawings and appropriate text. In short, I was unable to lay it aside until I had finished it. The au- [illegible] names reminds one of Edward Lear's *Non-* [illegible] former's effect is gained by use of real scientific names. The drawings remind one [illegible]

In spite of his mischievous jabs at the botanists, the author himself is a good, dependable botanist. His only entomological statement, however, is open to grave doubt. [illegible] learn, there is only one species of yucca [illegible] in the cactus belt.

[illegible]

Answer to Questions on page 183

[illegible] will go dry when the Canadian Fall re- [illegible]

INDIAN PLACE NAMES OF THE PENOBSCOT VALLEY AND THE MAINE COAST

[illegible]

A[illegible] country. He had in mind names derived [illegible] been compiled giving the origin and origi- [illegible] is a worthy addition to the list and is recommended to our readers. The author spent her leisure time for years identifying [illegible] then securing from the surviving tribe members the correct form of the original and its meaning. Interesting notes are given with each name, alphabetically arranged. Curiously enough, most of the names on the coast of Maine are identified as Micmac, whereas the traditional and historic home of that tribe was in Nova Scotia. For this the author has no satisfactory answer, except that they were fa- [illegible]

C. W.

CLOUDS AIR AND WIND

by Eric Sloane

Devin-Adair, $2.50

THIS [illegible] in these days of an air-minded world. In simplified language and with cartoon illustration, it explains the essential principles of meteorology. The text is short and yet entirely adequate and the cartoons are simple and well-done. They often have a distinctly humorous touch which, however, always serves to emphasize the principle being explained. The author is an artist of note, and also is a licensed pilot. As a result he has given much attention to those aspects of the weather and the atmosphere involved in aviation. Icing, fog, ceiling, visibility, and other factors are discussed and clearly diagramed in cartoon. Furthermore, there are fifteen excellent pictures of cloud forms, each of which also contains a "portrait" of some modern type of plane.

If you are an amateur who wishes to learn much about the factors involved in the daily kaleidoscopic story of the sky and the weather; or if you are interested, or have a son who is interested, in aviation, this book is to be recommended for your careful attention.

[illegible]

April

NATURAL HISTORY

1942

orth America in New York · Everglades Tribe · Masks

trategic Manganese · Heraldic Leo · G. G. Simpson

Good Neighbor Policy

NATURAL HISTORY

Introduce NATURAL HISTORY Magazine to your friends!!

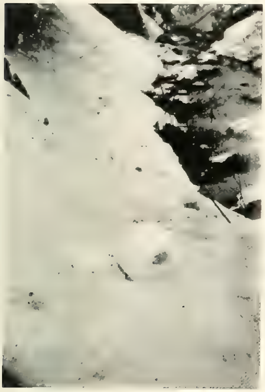
Send request for literature to the Membership Secretary

The American Museum of Natural History, 79th Street at Central Park West, New York, N. Y.

LETTERS

Sirs:

In your February issue of Natural History I read of strange snow formations found at the bottom of a hill near Schenectady, New York. A few days ago my sister and I noticed the same strange formations. Enclosed are two pictures of them. These "rolls" were at the bottom of a steep hill, but farther up we could see small "flaps" of snow just beginning to curl. My analysis of this is that the snow must be crusty and melting, the crust, becoming heavy, begins to curl and rolls down the hill.

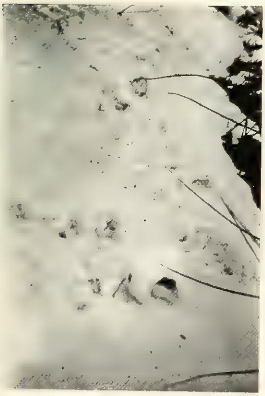


I might add that I enjoy your magazine and read each issue with great interest!

Mildred Dickeman,
(age 12)

Salt Lake City, Utah.

* * *



Sirs:

I believe that a fairly simple explanation will account for the beautifully photographed rings of snow, published on page 67 of your issue for February. In a word, I think the answer to the puzzle is *evaporation.* We all realize that when a heavy gob of snow falls from the limb of a tree and lands on a steep slope of sticky snow, it rolls downhill in such a way as to make a cylinder that is not only several inches to a foot in diameter but also many times thicker at the rim than in the center. On a warm day, the melting of the cylinder, especially if standing erect, would quickly cause the structure to collapse; but in a temperature below freezing the inevitable evaporation of snow particles would eat away the thinner center of the disk long before the rim showed any marked reduction in size or shape.

Wolcott Cutler.

Charlestown, Mass.

* * *

Sirs:

Mr. Featherstonhaugh's pictures of snow-rings in your February number have proved too suggestive of my own youthful exploits and those of my classmates in Switzerland for me to resist clearing up the mystery.

If the snow is "wet" and has a certain consistency, anybody can produce what may develop into rings like those shown. Make a snowball that is cylindrical instead of spherical and start it rolling down a steep slope. If the snow is just right, it will gather more and more snow as it rolls, so that it may be 30 or 40 inches in diameter when it reaches the bottom. Both pictures show quite clearly where the descending roll gathered up the snow.

At the beginning of the roll, the snow will gather loosely; then as the weight increases, the outer layers will be more and more tightly packed. The result is that, when the temperature grows warmer, the loose middle of the cylinder will melt much more easily than the tightly packed outside, and when conditions are particularly favorable during the melting process, a time will come when only a ring remains.

In the Alps, where open slopes are several hundred or even a thousand feet long, I have seen snow that was overhanging from a *crête* fall down, divide into lumps from the impact on the slope below and there create *natural* rolls in quantity, developing into the comparatively rare "powder" avalanches (as distinct from the ordinary ones occasioned by whole layers of snow slipping downward). Such rolls vary from the size of a fist to balls ten to twelve feet in diameter.

R. Farmer.

New York, N. Y.

* * *

Sirs:

I have learned a lot about snow-rings since the pictures I took were published in Natural History Magazine. In all, I had 22 replies to the letter . . .

Continued on page 188

Natural History

ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

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Above illustration Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

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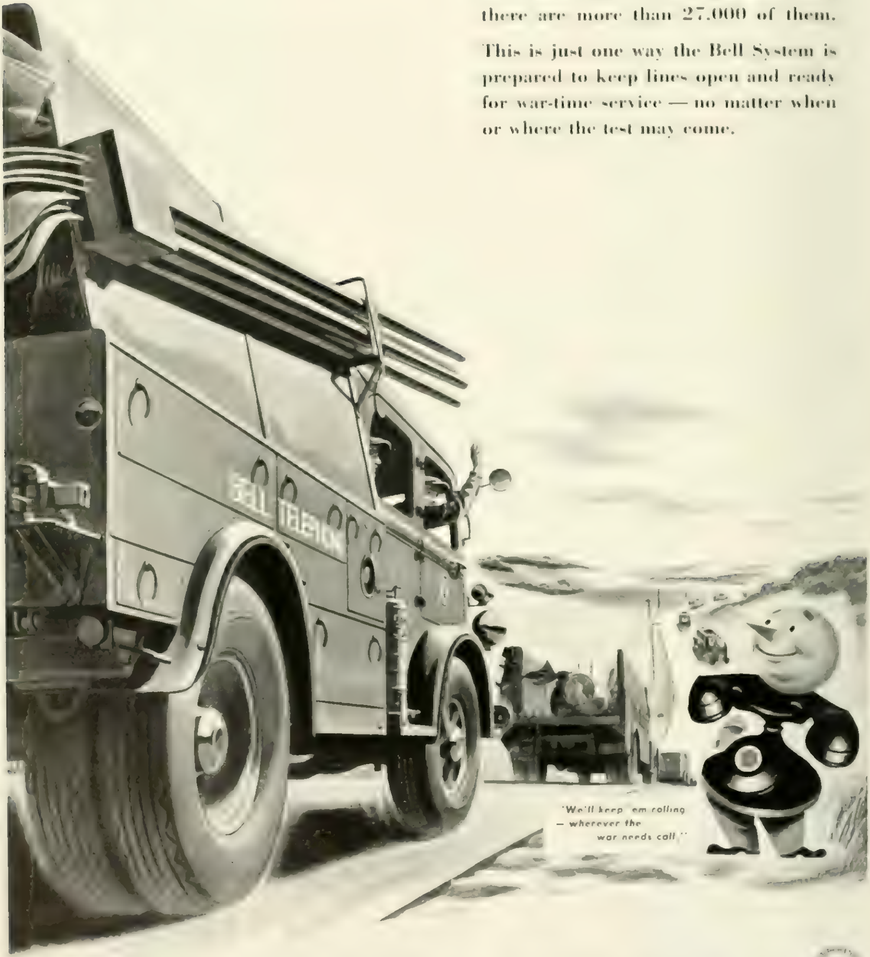
This is just one way the Bell System is prepared to keep lines open and ready for war-time service — no matter when or where the test may come.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BELL TELEPHONE SYSTEM . . . *Service to the Nation in Peace and War*

NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President WAYNE MOODY FAUNCE, Acting Director

VOLUME XLIX—No. 4 ★ ★ ★ ★ ★ ★ **APRIL, 1942**

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Detail of an exhibit in the new North American Hall
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[illegible]

Mr. [illegible] center of the snowball melting first sounds equally logical . . . I did not mention in my original letter that the snowballs, or rather snow-rings, in question could not have been formed by children. I found them in [illegible] the Helderberg Mountains, more than twelve miles from the nearest road. There were the tracks of one or two skiers through the section and a [illegible] the rings where the skiers apparently had taken off their skis to examine or photograph the phenomenon. There were no footprints leading up the bank or at its top.

These natural rings apparently are found in great numbers in the northern Adirondacks. Some of the persons answering my letter told of having seen as many as [illegible] It is indicated that the rings sometimes are from three to five feet in height.

[illegible]

Schenectady, N. Y.

P.S. A few minutes after writing the above I chanced to talk to a General Electric Company scientist who says he doubts Mr. Farmer's theory. He grants that certain meteorological conditions may melt the center of a natural snowball, but points out that in this event the hole in the center would not be a perfect circle, a feature that is common to all rings.

And thus the matter stands. Ed.

• • •

Sirs:

I was much interested in two of the articles in the February NATURAL HISTORY. May I felicitate you especially on that by Doctor Gudger? Such articles as this are splendid, inasmuch as they present sound and scientific knowledge in a form that is easily assimilated by the layman, and which cannot help but encourage interest in such matters.

I also wish to compliment you on the series of which "The Meek Inherit the Earth" is the February article. My son, almost six, after prolonged study of the chart accompanying "Grandfather Fish," explained to me that the fish was undoubtedly responsible for the airplane included in the chart, for, as the fish was responsible for man's presence, so it must be held accountable for this product of man's ingenuity.

In Dobie's article, he makes the statement that "the coyote is not strong enough to move a carcass in the manner of the mountain lion [presumably by carrying] [illegible] he must use his wits."

I have personally seen a coyote carry a four-months-old lamb in his mouth at a lope, until, hard pressed by a man on a running horse, the lamb was dropped as the little wolf jumped a four-foot woven-wire fence. That this was not unusual is indicated by the fact that over 30 lambs went the way of the one just mentioned. When the den containing the young coyotes was located, it was found to be approximately a mile from the pasture where the sheep were kept.

I. L. [illegible]

Houston, Tex.

• • •

Sirs:

I will always be thankful to the friend who first invited me to join the American Museum. I treasure every copy, but I do not hoard them. My pupils at school just about wear them out . . .

I hope the world situation will not make it necessary to change your publication.

Anne [illegible]

Norfolk, Nebr.

• • •

Sirs:

I am enclosing a check for $3.00 for renewal of my subscription to NATURAL HISTORY Magazine for another year.

I am indeed pleased with it, having taught school for 50 years, and now at the age of 82 I find many interesting things in it. If I were able I would like to visit the Museum.

A. R. [illegible]

Spokane, Wash.

• • •

Sirs:

I subscribed to your beautiful (and satisfying!) magazine—NATURAL HISTORY—last fall. . . .

I have not yet forgotten the wonderful day I spent in the Museum in New York —and that was 12 years [illegible] and hope I will again be able to visit it in the not too distant future.

Mrs. [illegible]

Toronto, Canada.

• • •

Sirs:

Your NATURAL HISTORY Magazine is being sent to me as a gift from our local paleontologist, Mr. W. H. Peck, and I prize it very highly.

I particularly [illegible] the biographies about various members and staff assistants of your American Museum of Natural History.

Each month I am looking forward to your magazine—and the biographies. Keep them coming.

Ruth M. Quam

Ekalaka, Mont.

• • •

Sirs:

Last year in each issue of NATURAL HISTORY there was an article by D. R. Barton on the life and achievements of a member of the Museum Staff. These were exceedingly interesting and fascinating, and since I noticed that these articles were discontinued in the January and February issues, I wanted to know for what reason you have decided to drop them. These articles were so interesting that I shall appreciate it if you will write and tell me.

Being an inveterate naturalist I deeply enjoy to the fullest extent your magazine NATURAL HISTORY and think that it is without doubt the most beautiful and fascinating nature magazine in the United States.

JOSEPH L. PARKHURST, JR.

Rahway, N. J.

Partly for the sake of variety and partly because a great many personalities have been presented in this way, the biographical articles have been temporarily suspended; but it is hoped that the series may be resumed in measure with the demand. Ed.

• • •

Sirs:

This is to tell you how much I enjoyed Doctor Gudger's article on the least fishes [November 1941]. I have read his things for years and must say they are becoming more suitable for a layman like me to enjoy. Of course, I could understand the early ones, but they were too technical for entertainment.

The make-up seems better, too. I don't know the technical terms, but I like the print, paper quality, spacing, etc.

Hope you will print more of Doctor Gudger's things if he continues his popular style.

Mrs. George Taylor

Mooresville, N. C.

DO NOT MISS

THE ITINERANT EEL, by Paul Bulla. Greeks named Jupiter their father. The canny Aristotle designated earthworms. Pliny pronounced them sexless. And centuries passed before mankind began to find an explanation for the baffling mystery. Now we know that newborn generations of this most extraordinary fish swim to their homeland after their parents have journeyed 2500 miles to give them birth far out in the mysterious Sargasso Sea, deep beneath the weed-clogged surface. How do they do it?

Plus the usual variety of short subjects, including **OUR CLEOPATRA**, by Mr. and Mrs. Edwin C. Weidlich, a word and camera chronicle of the odd life of an Egyptian tortoise in a modern American home.

NOTICE Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

THE
NEW HALL
OF
NORTH AMERICAN
MAMMALS
BRINGS
THE WILDLIFE
OF OUR CONTINENT
TO
NEW YORK CITY

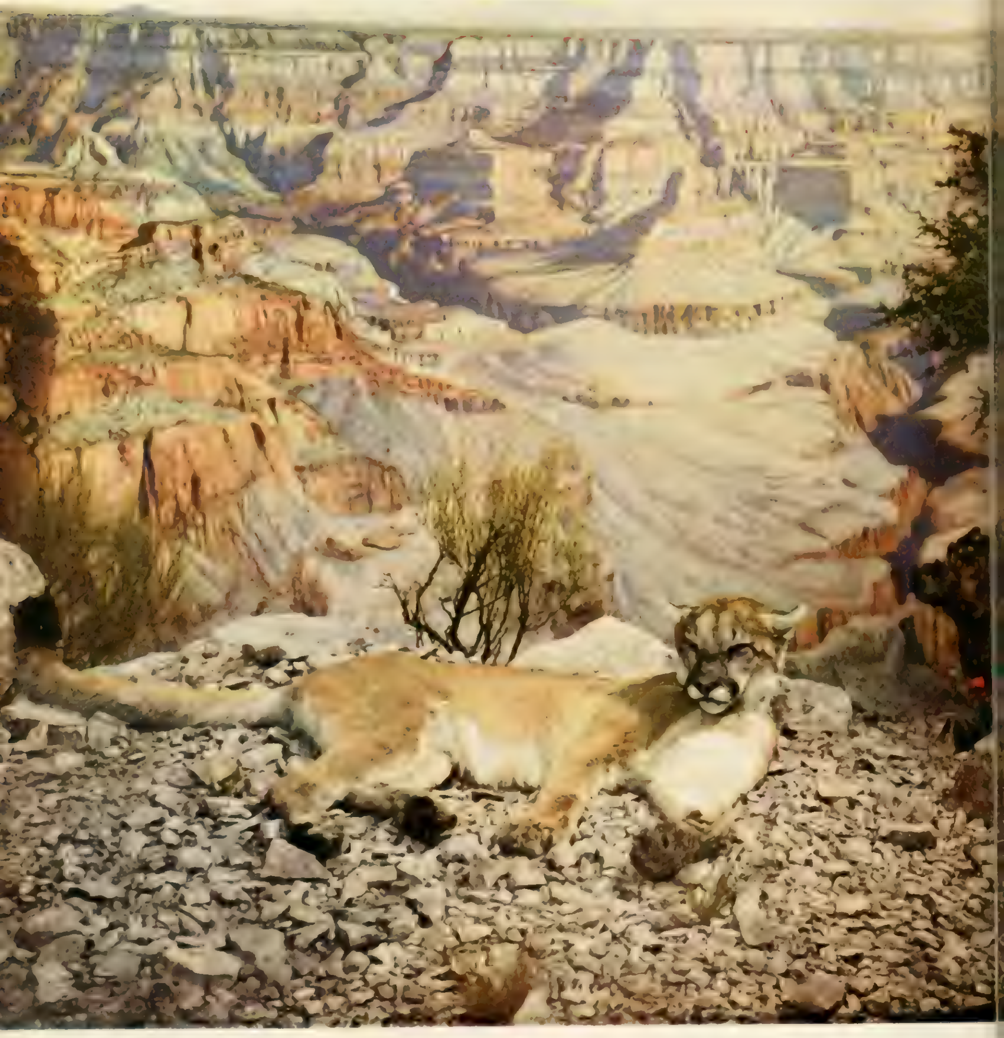
THE AMERICAN MUSEUM
OF NATURAL HISTORY

The American Museum
of
Natural History
PRESENTS

A GRAND

(Below) One of the most difficult animals to
in the wild, the cougar or mountain lion is
played in the new hall with dramatic rea
amid the spacious grandeur of the Grand Ca

[illegible]



OUR OF NORTH AMERICA

As on a magic carpet, the city-dweller can view the wildlife of our continent from Mexico to the Arctic in the new Hall of North American Mammals

By HAROLD E. ANTHONY

Curator, Department of Mammals, The American Museum of Natural History

THE splendid animals that are native to our continent, the scenic wonders that form their natural background in the wild, and the valuable lessons that can be learned from Nature, particularly in the conservation of our national resources—all these make the new Hall of North American Mammals a most important addition to the world-embracing exhibits in the American Museum of Natural History.

A hall depicting the life of our own continent had long been needed. In comparison with the modern halls devoted to African and Asiatic wildlife, our exhibits on North America were shabby and inadequate. The interest in our own North American fauna demanded that we do as well by the natives as by the aliens. The plan was set in motion, and eighteen separate expeditions, ranging from Mexico to Ellesmere Land north of Baffin Island and from the Atlantic Coast to the Pacific, have contributed to its realization.*

Embracing the expanse of North America thus covered, the new hall will bring to New York an impressive series of vistas into the best of primeval North America. Each animal group is an attempt to portray one or more species of mammal in an outstanding scene from the great outdoors. Many of these settings, such as Yellowstone Park, are favorite places of the tourist—regions selected by the government as National Parks because of their unique scenic and environmental values. Others are off the well-traveled routes. Mountain, desert, and arctic tundra, woodland and prairie—all types of geographic environment are represented in this comprehensive series of exhibits.

The selection of animals to go into the Hall has called for the most careful consideration. Animals having the greatest interest to the largest number of visitors have been given the most important positions. The hall has 29 alcoves, some of them very large. While the list of mammals in North America is a long one and no hall could show them all, even the lesser animals are properly represented in the smaller display groups. Whereas Akeley African Hall has a main hall and a balcony to devote to its exhibits, North American Hall achieves a practically equivalent display on one floor, as will be noted on the sketch plan of the groups.

This new hall is more than a hall of North American mammals. It is a hall of North American geography in a broad sense, a hall of North American ecology, with botany and all of the other environmental factors receiving the utmost attention. In planning the Mountain Lion Group, for example, the setting had to be one where this large cat was perfectly at home, a place where he belonged. The locality selected is the Grand Canyon. The lions themselves in the group are the obvious center of interest for the visitor; but they are only a single element out of many contained in the display. Beyond the lions, as far as the eye can see, stretches the breath-taking grandeur of the Grand Canyon, with the San Francisco Mountains in the distance, a spectacle unmatched anywhere in the world. It has been truthfully stated that no painting can do justice to the Grand Canyon. But a person in New York cannot see the Canyon itself, and this group is by all odds the next-best thing to being on the North Rim in person.

The casual visitor views the background in terms of enjoyment and entertainment, but a geologist sees in it a marvelous example of stratigraphy and of erosion on a stupendous scale. A student of botany or ecology—the science of plants, animals, and environment in their relation to each other—sees other things. He sees the flower known as the cliff rose growing out of the rock in the foreground, the cactus near at hand, the arid aspects of the landscape, and

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* Credit for the new Hall of North American Mammals is shared by several organizations and many individuals. Without the financial support given by the City of New York and the interested co-operation of the Mayor, the Comptroller, and of the Commissioner of Parks, the American Museum would not have had the building and the physical equipment for the hall. A special advisory committee for the hall has been in existence since the plans were in the blueprint stage. The late Madison Grant was chairman of this body for some years. Since active construction was begun the committee has been as follows:

ROBERT EARLL MCCONNELL, Chairman
CHILDS FRICK
DOUGLAS BURDEN
BEVERLEY R. ROBINSON
E. ROLAND HARRIMAN
H. P. DAVISON
MALCOLM P. ALDRICH
H. B. CLARK
RICHARD K. MELLON
HAROLD E. ANTHONY
JAMES L. CLARK

[illegible] abated when there is no ground cover to check it.

The new Hall of North American Mammals should appeal to all classes of visitors. To many the exhibits will be entertainment, which is certainly an important criterion for Museum exhibition. It is especially important during this period of world-wide turmoil, when the daily press and the radio continually [illegible] ogy. Even in a war-mad world, the outdoor man [illegible] can escape the sphere of man's domination, he will find the sun still shining, the plants and trees still green or budded with promise, and the animal life still pursuing the same pattern of life as during times of peace. The finer things of Nature are immutable, and man will be the better for it if he can divest himself of his own interferences with the universe and get back to first principles. The habitat groups of North American mammals will offer a valuable refuge and an opportunity for eyes weary of city streets to enjoy a grand tour of the North American continent. For a while at least, the visitor can lose himself in communion with Nature. He will not find it difficult to forget the barriers of glass and wood. The life-like animals are poised for action, and the illusion is so successful that one has the impression of observing living animals in their natural homeland, at closer range than is often offered the naturalist in the field.

Children will see for the first time many of the animals of our continent. They will learn the simpler facts in the life history of the animals from visual observation of the group and from the accompanying label. Many of the scenic backgrounds would remain an unknown world to them, unless they came to the Museum. Adults in search of education will get more from the groups in measure as their individual backgrounds afford the basis for interpretation, and in the direction their curiosity leads them. The sportsman needs little beyond the immediate visual stimulation to grasp the meaning of an exhibit showing an animal he has hunted.

For many visitors, the educational value of a museum is more effective if it is not too obvious and if it is sugar-coated. If exhibits are openly displayed as lessons, many visitors will turn aside because they are not in the mood. But even the individual frankly in search of entertainment is educated unconsciously if the exhibit is planned along the proper lines. Students or classes using the Museum for source material will find that the new hall offers great opportunities.

A great deal of special information can be given in [illegible] It is impossible to set forth on a label all the facts covering one of these habitat groups. Labels must be restricted to a size and prominence that will not compete with the group itself and act as a distracting influence in the hall. The beauty and the illusion of reality are lost if large, conspicuous labels catch the eye at every turn. They are like briliant signboards in the wilderness, and few would come to a museum on the primary appeal of labels. But the visitor can keep the guide leaflet to read at his leisure, if he does not care to do so at the side of the group while he is in the Museum. An outline or a syllabus will probably best serve the class in nature study, in ecology, or in geology. Such an outline would point out the salient facts as demonstrated in each group. It might suggest the best order in which to study the groups and refer to supplementary information that can be derived from other halls in the Museum and from collateral reading. The education and inspiration are there for those who seek them, for in these exhibits the visitor "Finds tongues in trees, books in the running brooks, sermons in stones."

The sex and age of the animals making up a group, as well as the posing of them, must be carefully planned in advance. A popular idea is to show male, female, and young, thus stressing the family associations. An invariable adherence to this pattern, however, would become monotonous and would prevent the display of much more interesting attributes. For example, male deer are most impressive in the fall of the year when their antlers are at their prime. At this season the young, on the other hand, are no longer tiny, spotted creatures; hence a fall group of buck, doe, and spotted fawn would be a biological misfit. This illustrates in a simple way a multitude of considerations, which extend to include flowers and other seasonal vegetation in an authentic group. Or again, among mountain sheep the rams with their massive horns are so much more eye-arresting than the ewes that they draw the limelight on any stage they occupy. Furthermore, during a large part of the year the big rams range in small groups apart from the ewes, so that it is good natural history plus good showmanship to plan a sheep group with the rams monopolizing the attention. Mountain sheep live in precipitous rugged topography, and as a foil against the mighty mountain background the powerful and majestic rams get first call on the foreground. The composition of the various groups can be studied, along with the explanations accompanying them, in the pictorial section following this article.

Though less than half of the groups are completed, the hall will be opened to the public on April 9th. Work is far advanced on five other large groups, and a beginning has been made on still others. Since the construction of such a large hall is an operation requiring years, the committee in charge decided to open it in advance in order to get the maximum use of the results. This will also enable visitors to see something of the groups under construction. To most people the actual creation of a group—the painting of the background, the assembling of the accessory material, the composing of the group itself—are matters of great interest. And the appreciation of the end product is increased if one has noted the careful and laborious steps by which it has been achieved.

None of the smaller groups have been completed, but these will round out the full picture of the animal life of our continent. And let no one think that because they are small they are of minor consequence. With the larger mammals, which are the game animals, the time of the year must invariably be fall, winter, or early spring. At any other time than the period of cold weather the pelage will be shabby or antlers will be unprime or missing completely. In the case of the smaller mammals these factors are not disturbing, and one can select a season when Nature has furnished a more gracious environment. Whereas a large mammal like the bison wears a worn or shedding coat in early summer, a skunk or a jack rabbit makes an altogether satisfactory exhibit at that season. Consequently, the smaller groups can go around the calendar and will provide the hall with spring and summer barkgrounds.

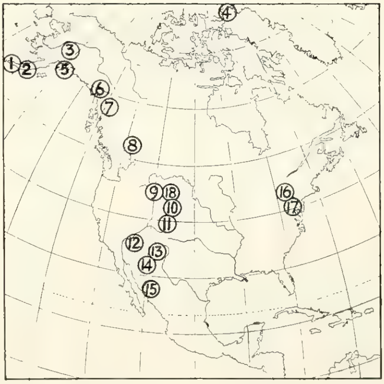
The average person who is familiar with the North American mammals of today does not realize the great variety of animal life from which they are survivors. Many mammals which now exist only in the eastern hemisphere had representatives in North or South America some thousands of years ago in the Pleistocene, or Ice Age. Sportsmen who marvel at the great variety of animals living in Africa today are interested to learn that our North American fauna of geologic yesterday was equally extensive and that many species have been lost with the advent of the Recent epoch. To give a brief survey of the predecessors of our existing North American mammal fauna, it is planned to have introductory exhibits at the entrance to North American Hall. These exhibits will show a few of the absentee members and give the visitor a better insight into the former riches of our continent.

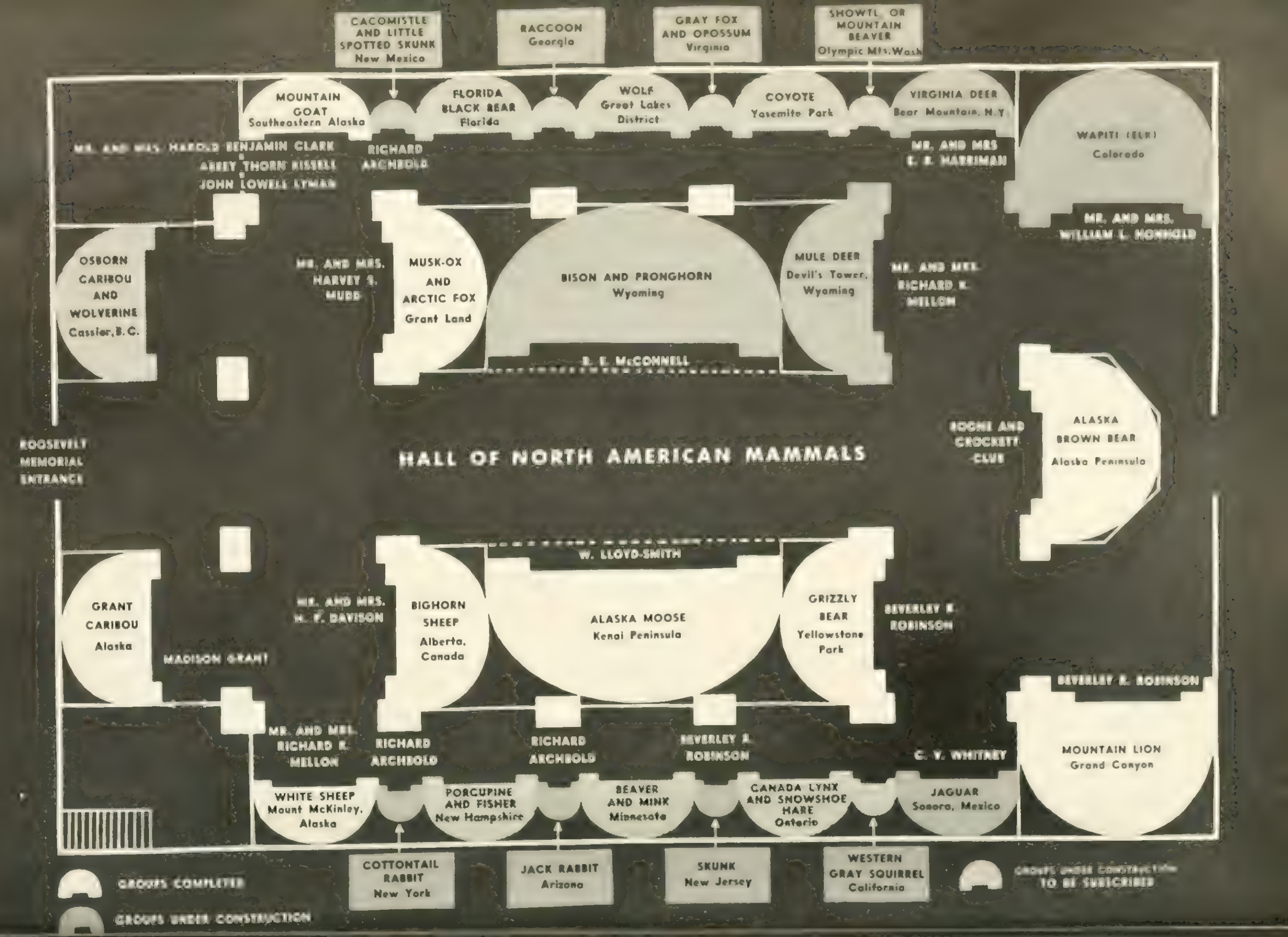
Other features of the hall which are planned but which will not be evident at the opening are the charts, maps, and diagrams which will be placed upon such of the walls as permit. These two-dimensional exhibits will cover a multitude of subjects having a direct bearing upon the distribution, evolution, and significance of the mammals on display. No class of animals can be discussed in the fullest terms if held apart from such fundamental factors as vegetation, climate, and topography. To understand the causes which make mammals look and act as they do, one must know something of their environment and of the forces which work upon all living matter. Many of the casual relations in this complex problem are yet to be discovered or formulated, but there are many factors which by association appear to have profound effects. Information of the latter character, such as distribution of forests, rainfall, desert, etc., will be given in chart form in some of these wall exhibits. The evolution of special structures or adaptations, such as the development of antlers through the life history of an animal, will also lend themselves to graphic display; and the rate of increase or decrease of various animals will illustrate many principles closely connected with the conservation of wildlife.

The pages following this article will show the reader something of the wide variety of informative and artistic material which makes the hall of North American mammals the foremost exhibit of its kind in the world. It will be open to the public on April 9th, and all are invited to come to see and enjoy it and benefit by its inspiration.

The work of eighteen expeditions is embodied in the displays in the new hall, and others will follow.

1. ALASKA BROWN BEAR
2. GRANT CARIBOU
3. WHITE SHEEP
4. MUSK-OX
5. MOOSE
6. MOUNTAIN GOAT
7. OSBORN CARIBOU
8. BIGHORN SHEEP
9. GRIZZLY BEAR
10. MULE DEER
11. WAPITI (ELK)
12. MOUNTAIN LION
13. CACOMISTLE & SPOTTED SKUNK
14. JACK RABBIT
15. JAGUAR
16. COTTONTAIL RABBIT
17. VIRGINIA DEER
18. BISON & PRONGHORN




HALL OF NORTH AMERICAN MAMMALS
CACOMISTLE AND LITTLE SPOTTED SKUNK New Mexico
RACCOON Georgia
GRAY FOX AND OPOSSUM Virginia
SHOWTL OR MOUNTAIN BEAVER Olympic Mts. Wash
MOUNTAIN GOAT Southeastern Alaska
FLORIDA BLACK BEAR Florida
WOLF Great Lakes District
COYOTE Yosemite Park
VIRGINIA DEER Bear Mountain, N.Y
WAPITI (ELK) Colorado
MR. AND MRS. HAROLD BENJAMIN CLARK
ABBEY THORN KISSELL
JOHN LOWELL LYMAN
RICHARD ARCHBOLD
MR. AND MRS. E. R. HARRIMAN
MR. AND MRS. WILLIAM L. HONNOLD
OSBORN CARIBOU AND WOLVERINE Cassiar, B.C.
MR. AND MRS. HARVEY S. MUDD
MUSK-OX AND ARCTIC FOX Grant Land
BISON AND PRONGHORN Wyoming
D. E. McCONNELL
MULE DEER Devil's Tower, Wyoming
MR. AND MRS. RICHARD K. MELLON
BOONE AND CROCKETT CLUB
ALASKA BROWN BEAR Alaska Peninsula
ROOSEVELT MEMORIAL ENTRANCE
W. LLOYD-SMITH
GRANT CARIBOU Alaska
MADISON GRANT
MR. AND MRS. H. P. DAVISON
BIGHORN SHEEP Alberta, Canada
ALASKA MOOSE Kenai Peninsula
GRIZZLY BEAR Yellowstone Park
BEVERLEY R. ROBINSON
BEVERLEY R. ROBINSON
MOUNTAIN LION Grand Canyon
MR. AND MRS. RICHARD K. MELLON
RICHARD ARCHBOLD
RICHARD ARCHBOLD
BEVERLEY R. ROBINSON
C. V. WHITNEY
WHITE SHEEP Mount McKinley, Alaska
PORCUPINE AND FISHER New Hampshire
BEAVER AND MINK Minnesota
CANADA LYNX AND SNOWSHOE HARE Ontario
JAGUAR Sonora, Mexico
COTTONTAIL RABBIT New York
JACK RABBIT Arizona
SKUNK New Jersey
WESTERN GRAY SQUIRREL California
GROUPS COMPLETED
GROUPS UNDER CONSTRUCTION
GROUPS UNDER CONSTRUCTION TO BE SUBSCRIBED

THE HALL OF NORTH AMERICAN MAMMALS

This panoramic exhibit of the animals of our continent in their natural settings embodies the latest and most progressive principles in scientific display.

Beginning some 30 years ago, a new ideal was envisioned in museum exhibiting. This ideal aspired to achieve new educational purposes through the realistic portrayal of wildlife in scenes of artistic beauty. Its realization depended upon the development of an elaborate new technique, and its watchwords have been truth, beauty, and faith in the value of Nature's lessons to man.

Many of the artists who helped to develop the method have also contributed their talents to the creation of this hall, which is thus a monument to their collective efforts and a climax in the evolution of a unique art. In admiration of its present and future implications, NATURAL HISTORY Magazine extends sincere tribute to their names.

ART AND TECHNICAL DIRECTION

James L. Clark
Albert E. Butler

SCIENTIFIC DIRECTION

Harold E. Anthony

ON THE PAINTING OF BACKGROUNDS

JAMES PERRY WILSON	Grizzly Bear Bison and Pronghorn Wapiti (Elk) Jaguar
FRANCIS LEE JAQUES	Musk-ox
BELMORE BROWNE GEORGE BROWNE assisting	Alaska Brown Bear White Sheep Bighorn Sheep Grant Caribou Osborn Caribou
CHARLES S. CHAPMAN	Mountain Lion
CARL RUNGIUS	Alaska Moose
JOSEPH M. GUERRY	Mountain Goat
FRED SCHERER	Virginia Deer Assisting on Bison and Pronghorn

ON THE MOUNTING OF ANIMALS

ROBERT H. ROCKWELL	Alaska Moose White Sheep Bighorn Sheep Grant Caribou Wapiti (Elk) Bison and Pronghorn Osborn Caribou Musk-ox Alaska Brown Bear
GARDELL D. CHRISTENSEN	Mountain Goat Grizzly Bear Virginia Deer Osborn Caribou Mountain Lion
GEORGE ADAMS	Mountain Lion Jack Rabbit

ON THE BUILDING OF THE FOREGROUNDS

GEORGE E. PETERSEN	Wapiti (Elk) Grizzly Bear
G. FREDERICK MASON	White Sheep Mountain Lion Alaska Moose Musk-ox Alaska Brown Bear Wapiti (Elk) Grant Caribou Osborn Caribou Bison and Pronghorn Bighorn Sheep
JOSEPH M. GUERRY	Mountain Goat Alaska Brown Bear Bighorn Sheep
PAUL M. WRIGHT	Jaguar Bighorn Sheep
CHARLES B. TORNELL	Bison and Pronghorn Wapiti (Elk) Bighorn Sheep
BERNARD F. CHAPMAN	Grizzly Bear
RAYMOND H. DELUCIA	Mountain Lion Grizzly Bear Bighorn Sheep Jaguar
JAMES CARMEL	Alaska Moose

Since the realistic effect of these displays depends to a great extent on special techniques in illumination, particular credit is due the Museum's departments of Construction and Lighting.

Alaska Brown Bear

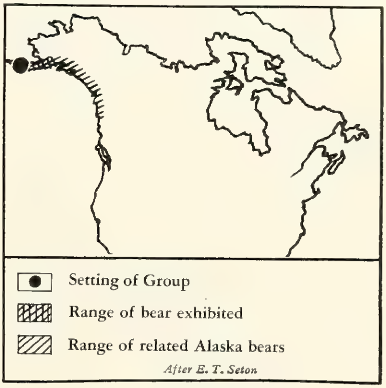
Ursus gyas Merriam

THIS huge bear is the first figure you will see upon entering the new Hall of North American Mammals. Its gigantic form, viewed against a background of towering Alaskan peaks, staggers the imagination. The Alaska Brown Bear sometimes weighs over 1600 pounds and is the world's largest carnivore. In ferocity, however, it does not have the reputation of the grizzly. Its great size is probably related to its abundant food supply. Hoards of salmon *(foreground, below)* run all summer, and the plentiful vegetable food of late spring and late fall is supplemented by mice, marmots, and carrion.

The brown bear goes into hibernation high on mountain slopes, sometimes as late as November, and emerges in April or May. These two males have just come down to the warm lowlands where there is more food. The cubs remain with the mother for about two years and apparently take six or seven years to reach full size.

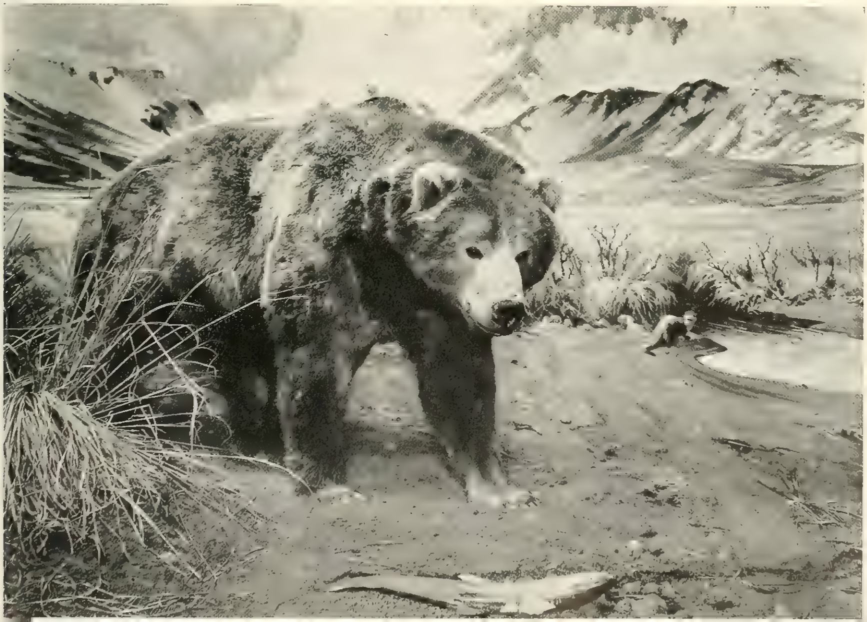
By the stream at right is seen a Pacific land otter, found from Oregon to Alaska. It swims in a series of leaps and dives, and likes to play on snow or clay "slides," down which it coasts on its chest headfirst into the water.

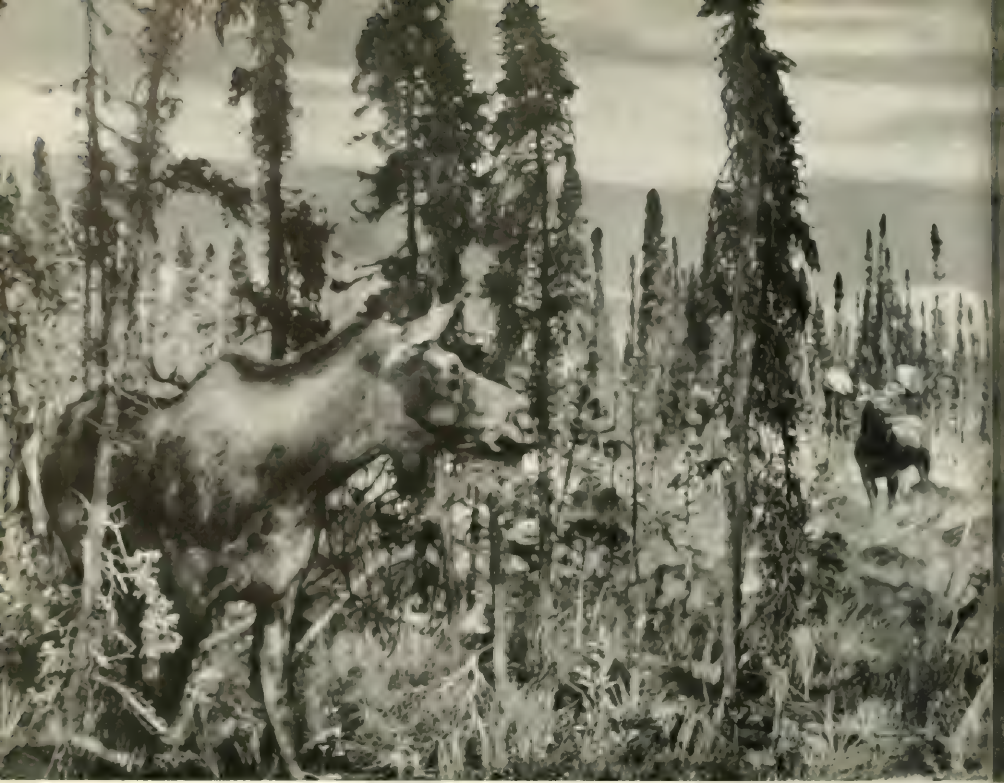
The volcanic mountainous background of this wonderful scene on the Alaska Peninsula dramatically illustrates the scooping action of glaciers and snow fields in producing **U**-shaped valleys and cup-like cirques.



The descriptive text accompanying these displays was assembled by NATURAL HISTORY Magazine from information prepared for the hall by George G. Goodwin, G. H. H. Tate, T. Donald Carter, and John Eric Hill

AMNH photos by Thane Bierwert





Moose

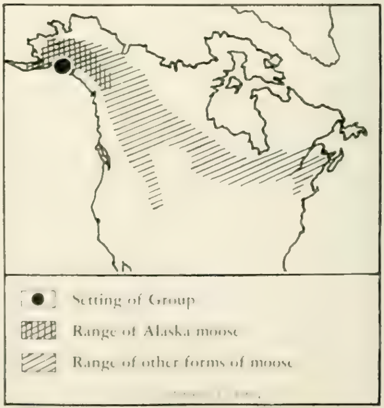
Alces gigas

Moose are the largest and grandest of the deer family. In the Kenai Peninsula and neighboring parts of Alaska they reach their greatest size both in stature and in horn development. The antlers on the bull on the right in this group represent the world's record in size and have a spread of $77\frac{5}{8}$ inches. New antlers are grown each year; the females have none. Males stand as high as six and one-half feet at the shoulders and weigh as much as 1400 pounds. The females are only about three-quarters as large as the males. Moose are found in northern Europe, Asia, and North America.

During the mating season terrific battles occur when two rivals encounter each other, as shown above. The noise of a moose crashing through brush and fallen timber, pausing occasionally to thrash at the shrubbery with his antlers, gives one the impression that nothing can stop his massive advance.

Next to man, the chief enemy of the moose is the wolf. The calves sometimes fall prey to bear and mountain lion.

Moose are forest-loving animals and prefer country with numerous lakes. In summer they enjoy wading into these lakes for protection from flies and mosquitoes and to feed on water plants. Moose are largely browsers, feeding on the bark, twigs, and leaves of maples, birches, alders, and willows.



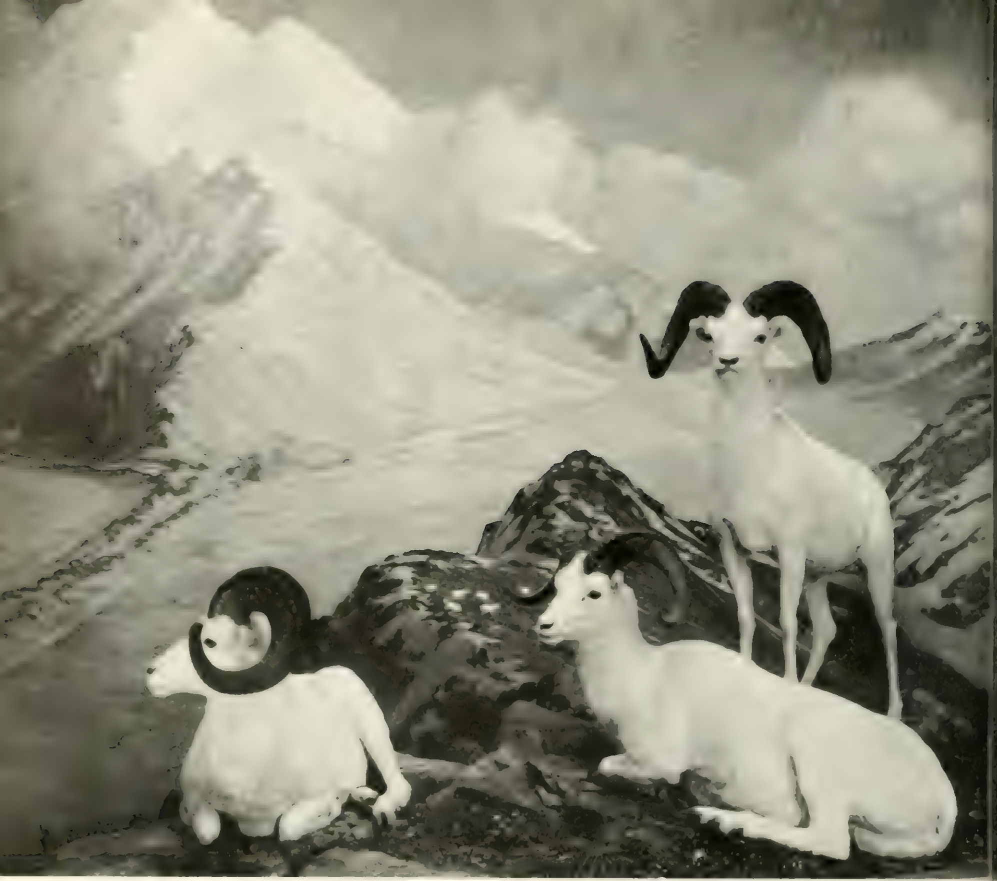
AMNH photo by C. H. Coles and R. E. Logan

Bison and Pronghorn

Bison bison bison and
Antilocapra americana americana

The photograph below is of a miniature model and illustrates the painstaking care with which every step is planned in the construction of a group. This exhibit, now nearly completed, faces the Moose Group along one side of the long central corridor of the Hall of North American Mammals. The scene is a historic one in Wyoming near where the famous Overland Trail crossed the North Platte River. It shows the well-known American bison, or buffalo, which once roamed over our Great Plains in countless millions, and the graceful pronghorn. The latter is the only antelope in the world with branched or pronged horns.

AMNH photo by Julius Kirschner



White Sheep

Ovis dalli Nelson

THE massive curling horns tell you that these are mountain sheep. Their pure white color indicates that they come from the North. Throughout Alaska, the coat of this animal is all white except for an occasional brownish stain. Farther south, in the Yukon, the coat darkens, until finally in northern British Columbia a very dark [illegible] found. This sheep is the subspecies known as *stonei*, or Stone's sheep.

These animals are expert mountain climbers and are not found away from steep and broken country. They are extremely sure-footed and climb up and down precipitous slopes where a man could not hope to pass. The sound of dislodged stone may be the first notice that they are above, though the adult may indicate its presence by a snort, or the kid by a shrill blat. When frightened, their tendency is to climb to the most inaccessible cliffs for protection. They have keen vision and depend more upon their eyes than upon their ears or nose to detect an enemy.

White sheep live only above timber line and spend their lives in a limited area, descending from higher altitudes only when forced down by snows. They are active throughout the year and may be seen at any hour of the day, but they often lie down to rest or take the sun after feeding in the early morning, to resume grazing only late in the day.

Although these animals are true sheep, their coat is hairy and not woolly. The horns of the females are smaller.

Musk-ox

Ovibos moschatus Zimmerman

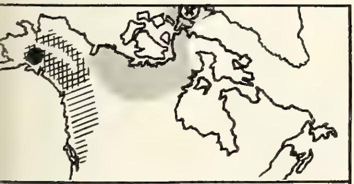
A SUPERB coat of heavy hair protects the musk-ox from the extreme winter temperatures of its arctic home, and the animal is able to secure food by pawing away the snow from the mosses and lichens on which it feeds. Unlike the Barren Ground caribou, which migrates north and south with the seasons, the musk-ox remains in the far north throughout the year.

In the Pleistocene or Ice Age, musk-oxen ranged over most of Europe, Asia, and what is now United States, but they vanished from these regions before historic times. Even in the past hundred years or so, their remaining realm in arctic America has become definitely smaller. Man is the musk-ox's worst enemy and is chiefly responsible for this.

Musk-oxen are found in herds of from ten to 30, formerly in much larger ones. When attacked, the herd forms a circle with the calves in the center, thus presenting a formidable phalanx to wolves—but not to men with guns.

The shaggy coat makes it easy to overestimate the weight of a musk-ox, but bulls do weigh 600 pounds or more and measure five feet at the shoulders. One is apt to think of musk-oxen as a sort of cattle, but actually they are more closely related to sheep and goats. Their nearest relative is the Himalayan takin. Usually the cow gives birth to a single calf, late in April or May.

AMNH photos by Thane Bierwert



● Setting of White Sheep Group

▦ Range of white sheep

▨ Range of the blackish race of white sheep

☒ Setting of Musk-ox Group

▒ Range of musk-ox

After E. T. Seton

[illegible]

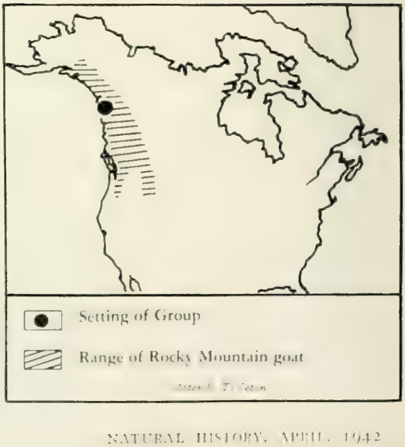
Mountain Goat

Oreamnos americanus Blainville

The mountain goat is not a true goat but belongs to the goat antelopes, or Rupicaprinae, which includes also the chamois, serow, and goral of the Old World. His home is on the high, sheer peaks of the mountains, far above timber line. His outstanding accomplishment is his marvelous climbing ability. In this he even surpasses the mountain sheep. Traveling along precarious cliffs where other animals dare not follow, he is safe from his natural enemies,—wolves, bears, and mountain lions. The eagle may occasionally take a kid but only when it is left unprotected by its mother.

The kids are born in April or May, generally one to a mother but sometimes two. Within a few days after birth they are able to follow their dams.

The food of the mountain goat consists of mosses, lichens, bushes, and grass. He does not descend into the lower levels during the winter, as do the sheep, but finds sheltered spots among the rocks for protection against storms. The crag represented above overlooks Alaska's Sawyer Glacier.



Mountain Lion

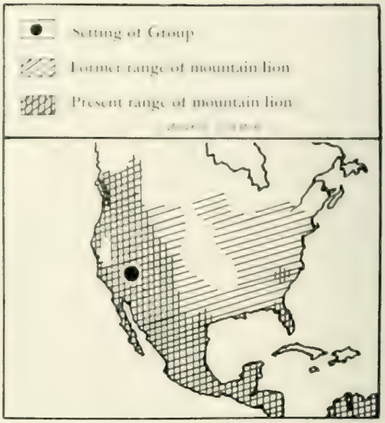
Felis concolor Linnaeus

I[illegible]

[illegible] but few attacks on mankind were recorded, and only a starving or cornered cougar is to be feared. They are shy and are rarely seen, even when common. Individuals will, however, follow a man for miles and prowl around camp, apparently from pure curiosity. They are readily tamed, especially when young, and remain docile and playful.

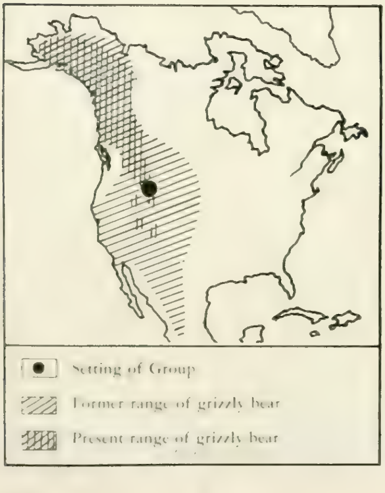
Cougars are usually found in pairs except for a short time after the birth of the young.

The background is the Grand Canyon, whose rock walls present the most complete record of earth history found anywhere in the world.


● Setting of Group
▨ Former range of mountain lion
▦ Present range of mountain lion

Grizzly Bear

Ursus horribilis Ord


● Setting of Group
▨ Former range of grizzly bear
▦ Present range of grizzly bear

THE name "grizzly" was given to this bear because of its unusual coloring. The word "grisly," meaning terrible, gruesome, or grim, was applied later but was evidently in the mind of Ord when he gave the grizzly the scientific name *horribilis*.

The grizzly bear is the most formidable and ferocious animal in North America, and yet, according to the best authorities, it rarely attacks man unless provoked. Its mentality is far inferior to that of the dog or wolf, but its powers of scent and hearing are highly developed. The favorite range of the grizzly is high rolling uplands, with rocky ridges and densely wooded thickets. Here it finds abundant food, consisting of roots, berries, nuts, insects, reptiles, fish, birds, eggs, and mammals ranging from mice to cattle. The young are born in the mother's winter den and are exceedingly small at birth. The second winter they den up again with the mother, but after that are able to shift for themselves.

Grizzly bears seem to communicate by a sort of signpost language. The bear bites a trunk high up, tearing the bark open crosswise, and often leaves [illegible] raking claw marks.

AMNH photo by Thane Bierwert

AMNH photo by C. H. Coles

[illegible]

Grant Caribou

Rangifer arcticus granti Allen

The animals in this group are a variety of Barren Ground caribou that are restricted to the Alaska Peninsula; thus they belong to a group having a wide distribution over the treeless tundra of the circumpolar regions. Caribou are the only deer in North America whose females have antlers. Both sexes shed their antlers annually.

The winter coat of this animal, with its thick growth of air-filled hairs, is weatherproof and affords fine protection from the cold. The large, spreading hoofs are suited for travel over the soft muskeg in summer and the deep winter snows where other hoofed animals would sink and flounder.

The home of the northern caribou is one of continuous travel. It summers on the tundra along the Arctic coast and migrates south for the winter months in immense herds, to the border of the forest belt. In the summer its food is grass and in the winter, lichens. The mating season is October, and the young are born in June.

The most formidable enemy of this caribou is the great white wolf, but bear, wolverine, and other predatory animals take a limited toll. During the summer months insects are a great menace to all caribou.

The caribou is an important source of subsistence to the people of the arctic regions, both in food and clothing.

Big-horn Sheep

Ovis canadensis Shaw

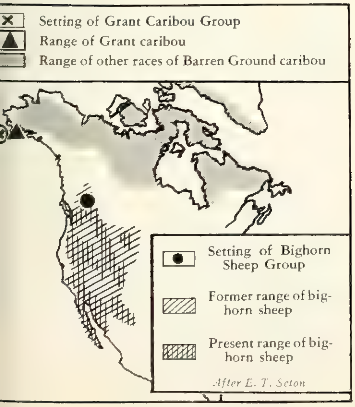
AMNH photo by Thane Bierwert

THE most coveted prize of the American big-game hunter, the bighorn sheep, inhabits the rugged mountains far above tree line and only descends when forced down by deep snow. Throughout most of the year, the older rams go about in small parties, keeping to themselves, while the ewes, lambs, and young rams form separate flocks. In late November the rams join the ewes, but after the breeding season they return to their former mode of life. The lambs are born in late May or June.

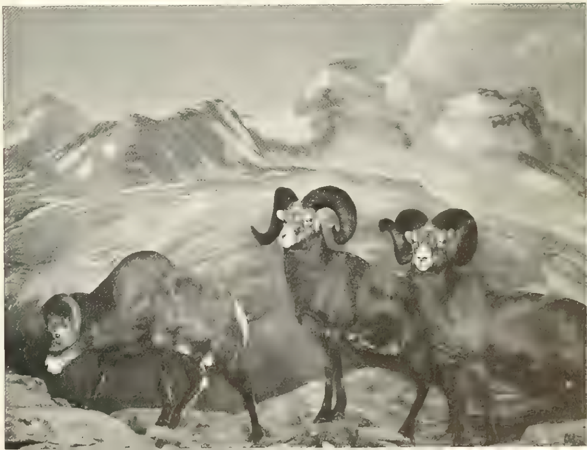
Besides man, the bighorn has many enemies. Coyotes, wolves, bears, mountain lions, lynxes, wolverines, and eagles,—all prey on the lambs, and the larger carnivores all enjoy a meal of mutton.

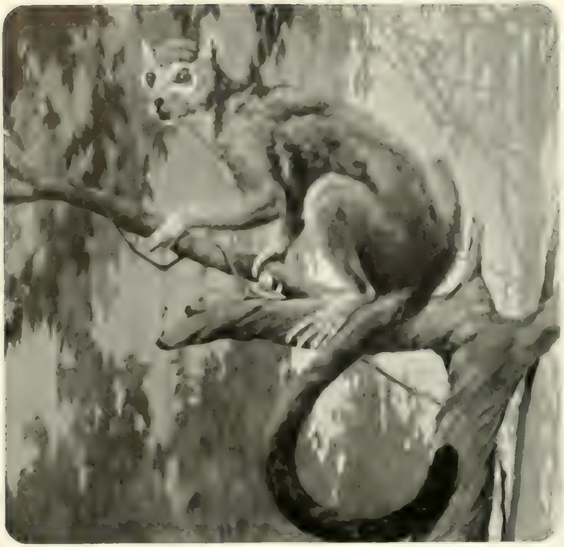
The horns on the right-hand ram *(also above)* are the world's record—49½ inches along the curve—and were donated by Dr. Henry M. Beck.

The scene is Jasper National Park, Alberta, and shows Mt. Athabaska as seen from the slopes of Mt. Wilcox at about eight o'clock in the morning.


☒ Setting of Grant Caribou Group
▲ Range of Grant caribou
▒ Range of other races of Barren Ground caribou
● Setting of Bighorn Sheep Group
▨ Former range of bighorn sheep
▦ Present range of bighorn sheep
After E. T. Seton

AMNH photo by C. H. Coles and Thane Bierwert





[illegible] Francis Lee Jaques

Sixth instalment in the story of animal life.

Both North America and Europe becam
the scene of conflict some forty or fift
million years ago when a host of ne
animals swarmed in, possibly from Asia
menacing all those who could not defen
themselves

NO MONKEYS appeared in the vanguard of the invasion, but their ancestors the lemurs were plentiful. A typical representative about forty million years ago was Notharctus, at left. Monkey-like hands, feet, and tail are characteristic of the lemurs, but the face is more fox-like. Lemurs did not survive in North or South America, but they are fairly abundant elsewhere today

No newspapers carried the headlines:

AMERICA INVADED

SHOCK TROOPS SWEEP
FORWARD

INFILTRATION TACTICS
THREATEN DEFENDERS

AMERICANS FALL BACK
WITH STUBBORN RESISTANCE

THERE were no reporters to cover this great invasion. No human eye saw it, for it occurred long before man had appeared on the earth, tens of millions of years ago: some say 40 million and some say 50 million. Yet it had a greater effect on history—yes, on human history as well as on earth history—than any of the military campaigns of the mere six thousand years or so of what we are pleased to call history.

It was not the first invasion of America and it was not to be the last; but it was in many respects the most fateful. Already incredibly old, the earth had seen many races come and go. Perhaps a billion years before this, the first protoplasmic life had moved in the dark waters. Slowly, gropingly, as aeons passed, cells had clustered together, had formed muscles, skin, nerves, and glands. Fishes appeared, equipped with a wonderful new structure, bone, that gave them internal support, solving the problem of increased size and of greater speed, providing rigid support and yet giving freedom of directed motion. Crawling out of fetid pools, gasping for oxygen, the amphibians had finally learned to breathe air during their adult life; and some of their descendants, the reptiles, had completely broken the long bondage to water, for even their eggs could be laid on land and could survive without the watery bath required by all the earlier forms.

Then had come a great time. Surely an observer, had there then been one capable of rational thought, would have decided that the goal of evolution was reached. Through the air flapped and soared ugly, bat-like pterosaurs. Swift as torpedoes, streamlined ichthyosaurs sped through the waters, while marine dragons, the mosasaurs, sported with them, and the clumsier plesiosaurs sculled more placidly along. Above all, on land the motley hosts of dinosaurs held sway. Yet all these saurians were but an incident in history, even though a long incident of perhaps 140 million years, and they vanished mysteriously and were as forgotten as if they had never existed, until their remains were dug up by curious men.

That long time when the dinosaurs and all the other -saurs lived and dominated life is called the Mesozoic. The name means "middle life," and appropriately refers to the Medieval Era, the Dark Age, of earth history. When the saurians died and the meek mammals replaced them as described in the February NATURAL HISTORY, the Cenozoic began, the "recent life" era. This was the beginning of modern history in the grand history of life, in which ten million years is like a century of human history. When students delving in the rocks first obtained some grasp of this sequence they found what seemed to be a fairly simple picture despite the multiplicity of its details. The dinosaurs were gone. Very well, that ended the Mesozoic. Mammals became abundant and no doubt they simply evolved into living faunas. So the period of that evolution can be called the Cenozoic, and for its first part no more appropriate

The Great Animal Invasion

By George Gaylord Simpson

Associate Curator of Vertebrate Paleontology,
The American Museum of Natural History

name could be used than Eocene, which means "the dawn of the recent."

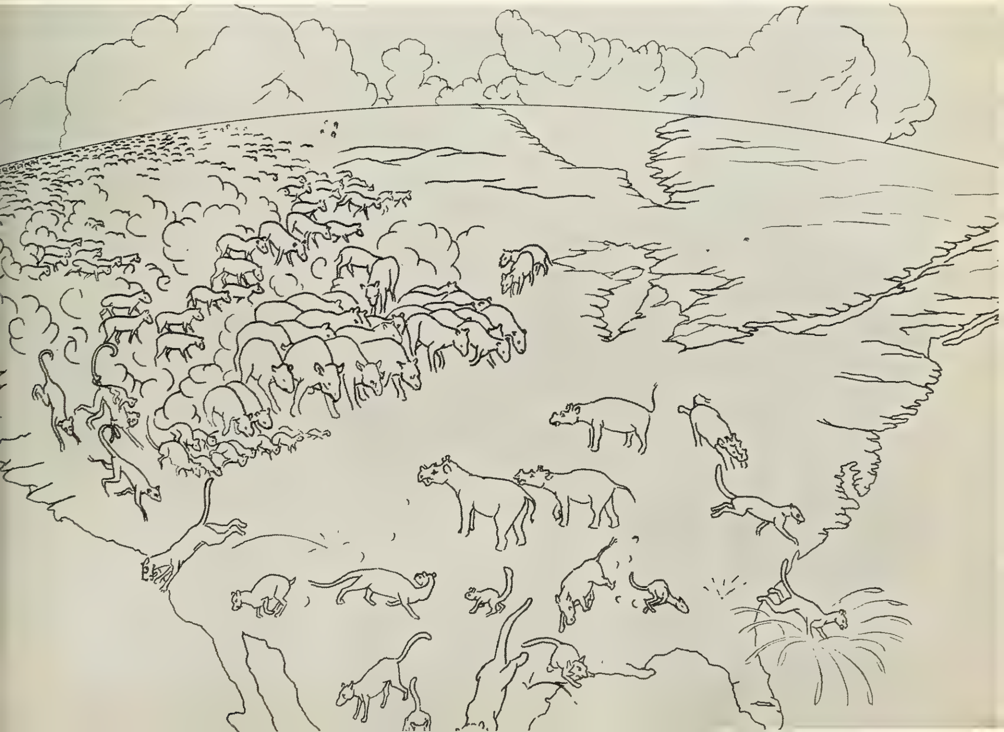
Now it is a troublesome fact that the more we know, the more we find to be known; the more we understand, the more appears that we do not understand. If they are acquiring some measure of wisdom and not merely being educated, students are likely to discover this distressing fact about the time they get into high school. Scientists, who are professional students and are paid for trying to find out a few of the multitude of things that ignorant man does not know, live all their lives with the discouraging conviction that their most distant journeys into the unknown are not much more extensive, relatively, than if they were ants setting out to explore North America.

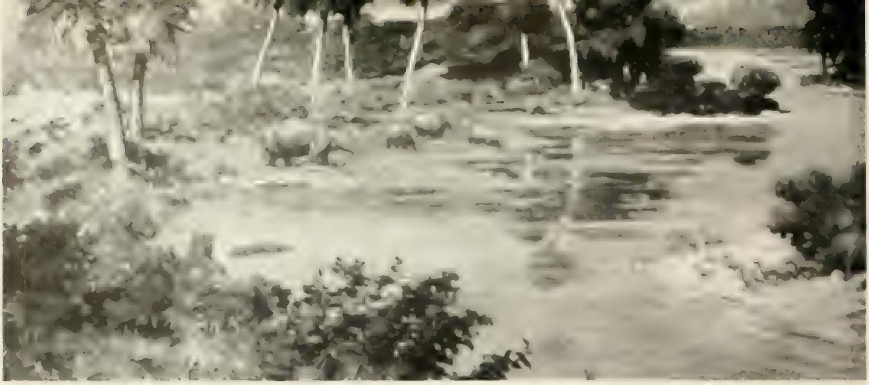
All this is by way of introducing the news that paleontologists had hardly named the Eocene and started the interesting task of tracing the descent of animals from that time to this, when they began to find facts that did not fit into the picture. They found that the Eocene did not immediately follow the extinction of the great reptiles at the end of the Mesozoic, but that some time intervened. The longer they studied, the longer this interval appeared to be, until now it is believed to have lasted for at least ten million years, possibly fifteen million. Rocks deposited in that interval are not very widespread; but now almost a complete sequence of them has been found in our Rocky Mountain states, and some strata representing more limited parts of the interval have also been found in Europe, Asia, and South America. Fossils occur in these rocks and they show that mammals were the dominant, common animals of the time.

So far, so good. This unexpected interval belongs to the Age of Mammals and fits into the Cenozoic. The name Eocene had already been given to a later epoch before it was found that this was not really the beginning of the Cenozoic, so a new name had to be coined for the true beginning and it has been called Paleocene, which means "ancient-recent." It is a rather absurd appellation if taken literally, but paleontologists agree to use it, and it serves all the purposes of a name and is less confusing than if the

No one knows just where the invading animals came from. South America, then separated from North America, avoided the invasion until several million years later

Drawing by John C. Germann





THE GROTESQUE ARCHAIC uintatheres *(center)* were doomed to extinction when faced by progressive invaders like the ancestral horses *(right)*

[illegible] Eocene [illegible] changed.

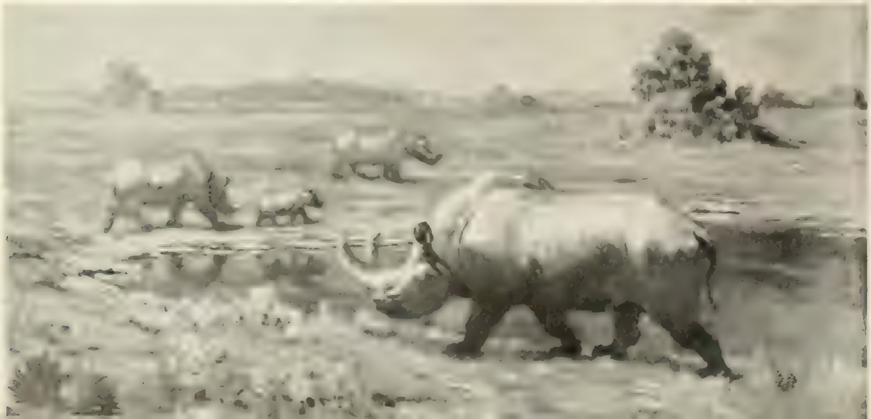
The [illegible] was that the mammals of this unexpected extra epoch, the Paleocene, do not simply grade into the ancestry of modern mammals. Something very queer, and at first sight inexplicable, happened at about the beginning of the Eocene. Take the ancestry of the horse, for instance. Everyone knows that this can be traced back almost continuously to little Eohippus, a small animal with four front and three hind toes that lived in Europe and North America at the beginning of the Eocene, the "dawn-horse" in the "dawn of the recent." But where did Eohippus come from? Since the long Paleocene, with its varied mammals, preceded the Eocene, obviously it is the place to look for the ancestor of Eohippus.

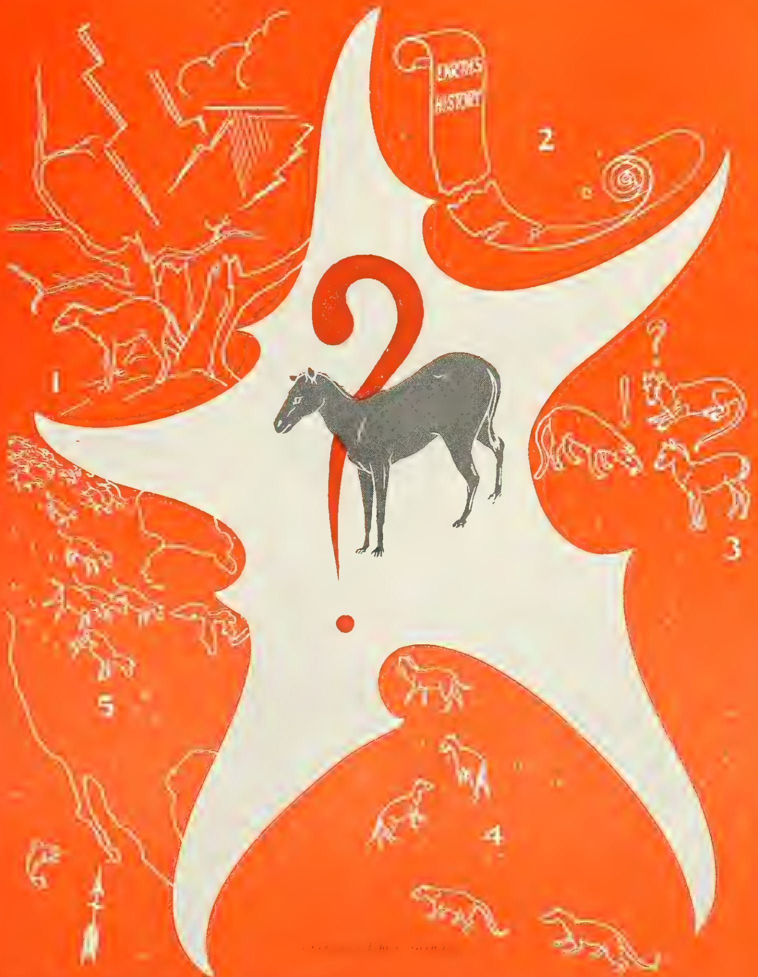
There are, indeed, animals in the Paleocene that could have given rise to Eohippus. These are the condylarths, the first hoofed, herbivorous mammals, described in the February NATURAL HISTORY. The problem seemed to be solved, but paleontologists continued to pry and they learned so much that they found that they knew less than they had thought. They found that the condylarths evolved slowly and steadily through the Paleocene but that when Eohippus appeared the condylarths were still here and were still much more primitive than Eohippus and quite different. Apparently these condylarths, at least those known in North America, did not evolve into Eohippus. The same sort of difficulty appeared not only for the horses, but also for all the modern types of herbivores, the pigs, cows, antelopes, and the rest, and for the rodents and for many other recent types of mammals.

Here are the makings of a game more exciting than "Murder" and more difficult than crossword puzzles. The reader can try it, if he likes, as a superior sort of guessing game. The question is: *Why does the first animal we can class as a horse differ so much from its only possible known ancestors?* The scientific method of attack on the problem does, indeed, follow some of the lines of a guessing game. A first step is to think of all conceivably possible explanations. In scientific research these are called "multiple hypotheses." You might try this yourself before reading the multiple hypotheses that scientists have set up for this particular problem. The most important of these hypotheses are:

SOME OF THE INVADERS, like the great titanotheres *(below)* progressed so rapidly that they, too, became specialized and then extinct

Painting [illegible]





FIVE HYPOTHESES are considered in explanation of why horse ancestors appeared suddenly in North America. They are:

1 that Eohippus, the Dawn Horse, was created by divine act

2 that the geologic record in North America was interrupted during the time when Eohippus was evolving

3 that certain animals unlike Eohippus but related to him, suddenly gave birth to a litter of Dawn Horses

4 that fossil hunters in North America have as yet merely failed to find the connecting links in horse ancestry, and

5 that the Dawn Horse was evolved elsewhere than in North America and arrived on this continent along with other invading animals

[illegible] considered by any thoughtful inquirer. This is no place to go over the threadbare arguments, but if you [illegible] sequence from Eohippus to modern horse is very well known and shows beyond question that the latter is derived from the former; but some condylarths are much more like Eohippus than Eohippus is like the modern horse.

2. Eohippus did arise from condylarths in a (hypothetical) long interval between Paleocene and Eocene when no known rocks, and hence no known fossils, were deposited. This is a plausible hypothesis, but, as it happens, one that can now be disproved beyond any doubt. One of several conclusive lines of disproof is this: condylarths are known both in the late Paleocene and in the early Eocene contemporaneous with Eohippus; they are very much alike in the two epochs; if they changed so little, no length of time sufficient for the slow origin of Eohippus can have intervened.

At which point you may interrupt me to say, "How about the scare headlines with which you began this article. Was that just a come-on to get me to plow through all this stuff?"

"Not at all," I would answer. "This 'stuff' as you call it, has a very direct bearing on those headlines. We'll be back to the invasion sooner than you expect."

3. Eohippus did arise from the condylarths, but did so all at once and not slowly. Perhaps condylarth mates suddenly had a litter of Eohippuses at the beginning of the Eocene. In the nature of things, this hypothesis cannot be ruled out categorically and some respectable scientists (as it happens, not those best acquainted with the facts of mammalian history) do support it. Nevertheless it is so improbable as to be unacceptable unless we can find no hypothesis more likely to explain the observed facts. No such radical jump ever occurred in the later evolution of the horse, or in any other group represented by a good fossil record, so what logical right have we to assume that it happened here unless there is no other explanation?

4. Some line of American condylarths, evolving more rapidly than those known, did give rise to Eohippus during the Paleocene but simply has not been discovered. Again, the hypothesis cannot be disproved—who can say what may yet be discovered? It was even a likely hypothesis before much was known about the American Paleocene, but as hundreds and thousands of Paleocene fossils are found, [illegible] environments suitable for Eohippus, and not a scrap of a real Eohippus ancestor appears, the chance that such ancestors occurred here is being reduced to the vanishing point.

5. Eohippus evolved from condylarths some place else and it appears suddenly at the beginning of the American Eocene because something—perhaps the rise of land joining various continents—then permitted the herds of Eohippuses and other typical Eocene mammals to invade North America.

This is the favored hypothesis of paleontologists. It explains all the known facts, no fact contradicts it, and it is supported by other observations and theories on all sides. Thus it becomes something more than a hypothesis (which is a scientific guess set up for examination and testing) and becomes a full-fledged theory (the most probable, best supported explanation of a body of observations). The next step—from theory to an attested fact—would be the finding of the ancestry and the tracing of the actual steps of the invasion radiating from a center. Such a discovery has not been made. Perhaps it never will be; it is quite possible that the center of origin is now sunk beneath the sea or that no fossils survive in it. But in any case the theory is established and seems almost certainly to be true.

Ancestors from abroad

With a few exceptions, the known American Paleocene mammals were archaic types. They were related to the ancestry of later mammals and give us some idea of what those ancestors were like, but they were not themselves the real, direct ancestors. Life today would be very different if the Paleocene mammals had continued to occupy the earth and to evolve into the only living types. Hardly a single mammal that we know today would have existed. The ancestors came in during the Great Invasion.

This did not happen all at once. Some groups invaded earlier, some later, but the climax of the change came at about the beginning of the Eocene, so that the name of the "dawn of the recent" epoch is still appropriate. The archaic Paleocene groups did not die out all at once, either. Most of them were certainly doomed, because they were less efficient or less intelligent than various modernized mammals of similar habits and could not win in the long competition. Nevertheless many of the archaic mammals hung on, some of them for millions of years, and continued to evolve in their own ways before they finally succumbed.

Let us briefly review a typical mammalian fauna of, say, the middle Eocene when the invaders were well established but some of the ancient inhabitants were still holding out. A good example is the fossil fauna of the Bridger Basin of southwestern Wyoming. In the middle Eocene much of this region, now barren, was heavily forested. The animals roamed through the forests, glades, and smaller savannahs of a broad valley. Distant volcanoes thundered; falls of volcanic ash were frequent, but seldom so dense as to cause wide slaughter. To the south was a lake basin already almost filled by millenniums of ash falls and by the sediments of rivers but still with shallow open water in the middle Eocene.

To the instructed eye, perhaps the most striking animals of the time were some of the smallest, the rodents. The rodent-like multituberculates of the Mesozoic and Paleocene were among the first of the archaic mammals to fall before the invaders. Now, in the Eocene, they are all gone and in their places are multitudes of true rodents. Numerous as these are, they are not nearly as varied as are the recent rodents of Wyoming. They are still primitive, just beginning to specialize in various directions, and all are more or less squirrel-like,—for squirrels, despite a few specializations, are about the most primitive of rodents surviving today and therefore most like these ancestral forms.

Passing giants

The largest and most impressive animals are the uintatheres, almost as large as elephants and elephant-like in their bodies but with very different heads, elongate and provided with three pairs of blunt, horn-like protuberances. Although they are herbivores, they have great saber-like canine teeth and use these to fight, not to kill prey. The fate of the dinosaurs is sufficient warning that size is not adequate insurance of survival. Indeed, these grotesque uintatheres are stupid survivors of the archaic fauna and they are to die out by the end of the Eocene.

Other archaic herbivorous survivors are condylarths, so varied in the Paleocene but now reduced to one kind which is, nevertheless, abundant, and taeniodonts, strange misfits that we saw at the beginning of the Paleocene. Both these groups, like the uintatheres, are destined not to survive the Eocene.

But there are others,—more varied and more numerous herbivores of modernized groups, Eocene invaders prophetic of the future. Among these are ancestral horses, Orohippus, differing little from its immediate ancestor Eohippus. Rhinoceroses are particularly common and there are many different sorts. Ancestral tapirs also occur. There are many titanotheres, odd-toed allies of horses and rhinoceroses and therefore modernized or progressive. They evolved more rapidly to a maximum and became extinct in the next epoch, the Oligocene. Even among the modernized groups that invaded in the Eocene there were many aberrant side lines that do not survive today.

The even-toed hoofed mammals, later dominant among all herbivores, are present in this middle Eocene fauna but are still rare. As yet only a few occur, rather small and too primitive to describe in terms of recent animals. Later their evolution seems to have speeded up and they passed the odd-toed forms, giving rise to such diverse creatures as pigs, hippopotamuses, camels, deer, antelopes, sheep, cows, and many others.

Flesh-eaters largely archaic

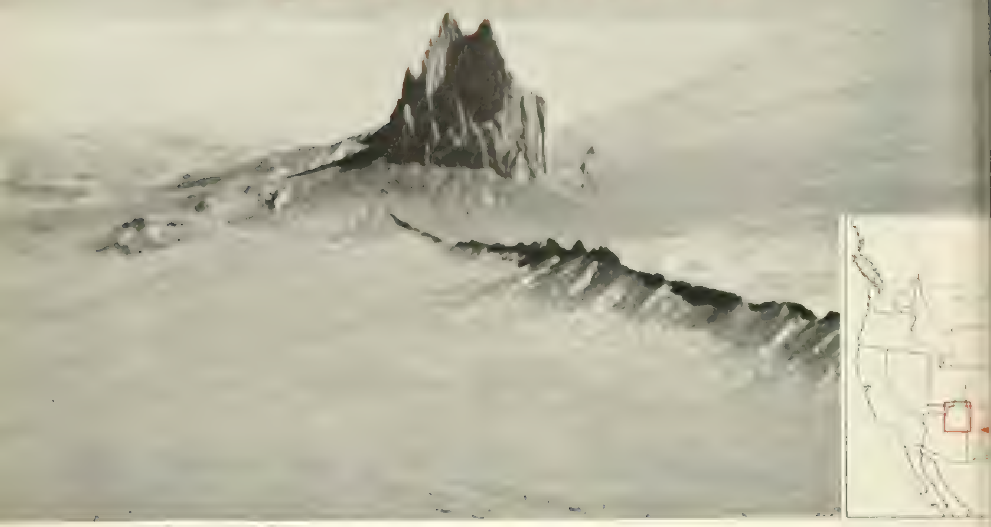
What of the flesh-eaters that preyed on all these herbivores? Here it is curious to note that the archaic types are still dominant. Varied creodonts, much like those of the Paleocene but in some cases swifter or more powerful, have developed from Paleocene ancestors without being replaced by invading modernized types. Some, indeed, are relatively advanced but the most potent invaders, of the cat, dog, and weasel families, had not yet made their way into North America. When they did, in the next epoch, the creodonts did not long survive the competition.

Perhaps the greatest popular interest is attracted by the presence of numerous primates, for this group of mammals includes the monkeys, apes, and man. None of these higher types, not even one as high as a monkey, has yet appeared in the middle Eocene; but lower primates are common, especially primitive lemurs. The lemurs, some of which still survive in the warmer parts of the Old World, have monkey-like hands, feet, and tails, but most of them have long, fox-like faces instead of the short, flattened faces so typical of monkeys—and of man, for that matter. (Our naked, smashed-in snouts perhaps look quite disgusting to a lemur.) The primate invasion started well back in the Paleocene, but the commonest middle Eocene type, a fairly typical primitive lemur called Notharctus, is of a more modern stock that invaded with Eohippus at the beginning of the Eocene. For some reason primates did not do very well in North America, where only a few survived the Eocene and none the next epoch, the Oligocene. That they survived abundantly elsewhere in the world is history.

The Great Invasion occurred almost simultaneously in Europe and North America and, as already mentioned, its source is not clear, although a number of students think that the main source, at least, was somewhere in Asia. Now it has been found that essentially the same invasion occurred in South America at a very much later date and under circumstances that permit its being followed from start to finish in considerable detail. This clear example helps to support the theory of an Eocene invasion in North Amer-

Continued on page 236

The Story of
SHIPROCK



New Mexico's famous landmark is a memorial to a volcanic explosion that made the "four corners" a scene of desolation five million years ago

By H. E. VOKES

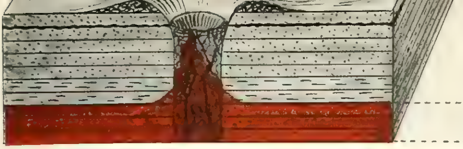
Assistant Curator of Invertebrate Paleontology, American Museum of Natural History

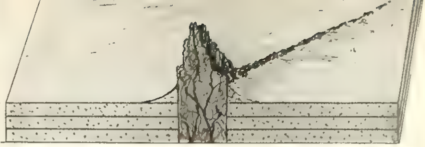
TODAY it is a desert region, a land of bare rocky plateaus rimmed with stark walls of rock; a land of forbidding, dry, hot valleys; of little vegetation and less water; a region of scorpions, rattlesnakes and centipedes. Some five million years ago, it was an Eden, a region with lush vegetation and abundant life, with horses, camels, mastodons, and beavers, with amphibians in its swamps and fish in its sluggish rivers; a pleasant region with a warm, moist climate.

On a summer morning, in those early days, a herd of giant camels was lazily browsing near the margin of one of the many small lakes that dotted the landscape. Suddenly and with a great roar a large portion of the land blew up and great fragments of rock were thrown high into the air. Many of the camels were killed outright, others were thrown down by the force of the blast and were overwhelmed by the falling debris before they could escape. They could not know it (and the knowledge would have given them scant solace), but millenniums later paleontologists were to find their remains and by them date the approximate time of the catastrophe. That day they were but dead camels, buried with a mass of broken vegetation under a welter of fragmented rocks and dust that showered down from a great funnel-like crater. The crater itself was also filled almost to the brim by similar fragments, among which thin streams of lava forced their way upwards toward the surface, cementing the rocks together into a hardened, consolidated mass.

Years passed, millions of years, during which the crater was filled with water-borne debris. The rim was washed away and the whole evidence of the episode was covered by later deposits.

Then came a time when the entire region and many adjoining ones were slowly lifted high above their former level. No longer did the rivers sluggishly flow into the basin, carrying their small loads of sand and depositing them in its lakes and swamps. Now the climate was drier, and the streams became intermittent, subject to sudden floods during periods of heavy rain. They flowed away from the basin, towards the lower lands off the plateau, gouging deep canyons and cutting back into the basin. The soft, river-laid sediments were mostly washed away. In





Drawings by John P. [illegible]

FIVE MILLION YEARS AGO

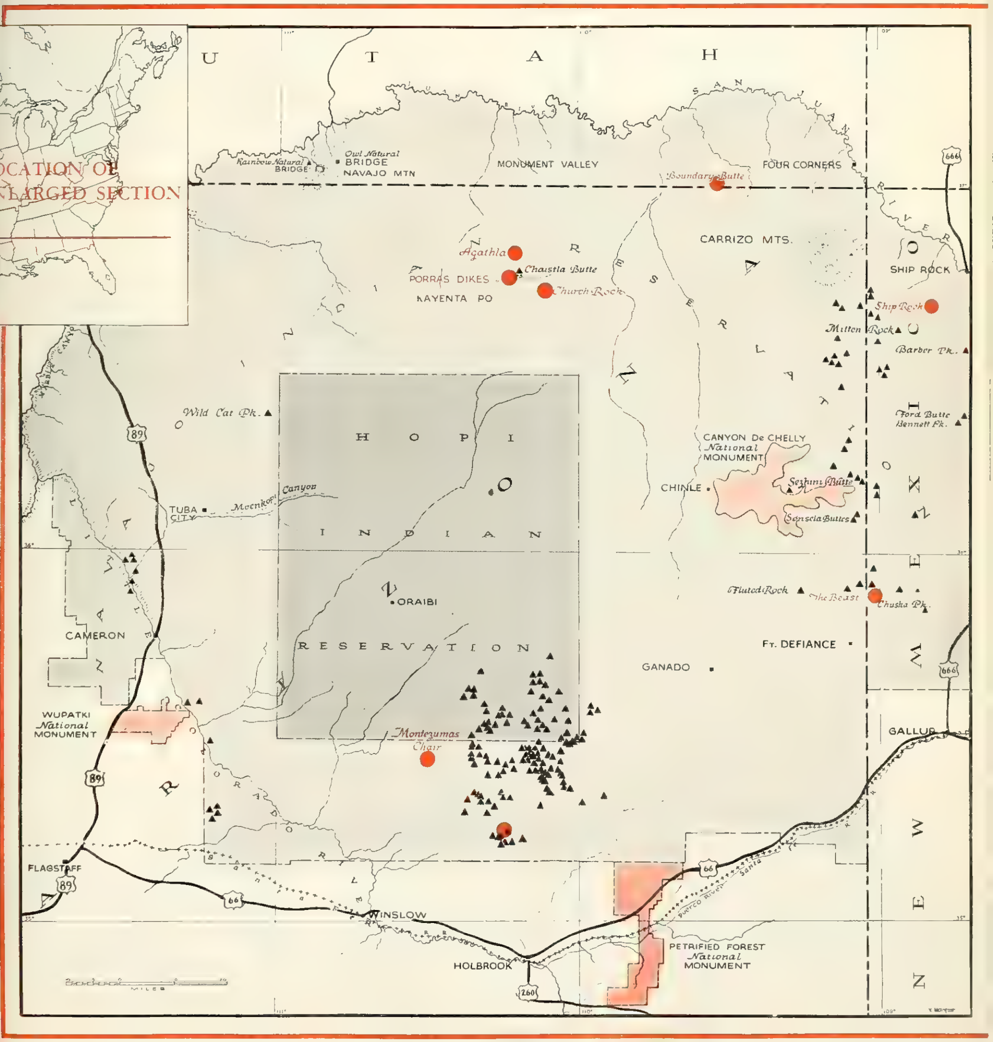
A violent explosion rent the mild and verdant land. Fragmented rocks showered over the surrounding area and its inhabitants. Similar fragments also lodged in the volcanic throat, where they were cemented in place by lava

(Left) A REMARKABLE view of the 1400-foot rock that has been likened to a ship under full sail. The dark wall of rock extending out from the base is a "dike." This resulted when the earth was fractured by the volcanic explosion. The intruded lava resisted later erosion

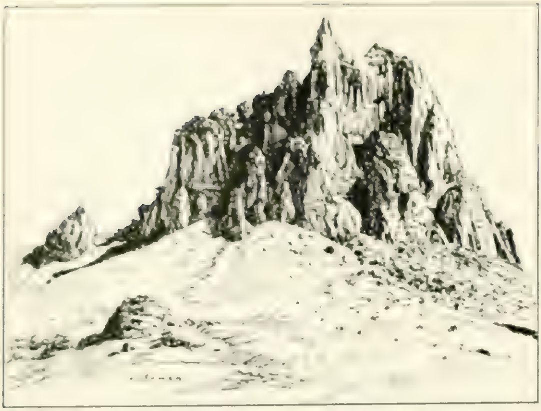
TODAY

Shiprock as we know it stands in a barren plain, for the climate has changed. The softer material round about the hard volcanic neck was weathered away, leaving an imposing tower of rock to remind us of this distant event

THE EXTENT of the volcanic activity which produced Shiprock is evident from the almost 200 other volcanic necks marked on the map below as triangles. Secondary roads passable in good weather reach interesting sections. Circles indicate necks illustrated on following spread



LOCATION OF
ENLARGED SECTION
U T A H
SAN JUAN
Rainbow Natural BRIDGE
Owl Natural BRIDGE
NAVAJO MTN
MONUMENT VALLEY
FOUR CORNERS
Boundary Butte
CARRIZO MTS.
Agathla
Chaistla Butte
PORRAS DIKES
KAYENTA PO
Church Rock
NAVAJO INDIAN RESERVATION
SHIP ROCK
Ship Rock
Mitten Rock
Barber Pk.
Ford Butte
Bennett Pk.
Wild Cat Pk.
HOPI INDIAN RESERVATION
TUBA CITY
Moenkopi Canyon
ORAIBI
CANYON De CHELLY National MONUMENT
CHINLE
Sezhini Butte
Soniela Buttes
Fluted Rock
The Beast
Chuska Pk.
FT. DEFIANCE
GANADO
CAMERON
WUPATKI National MONUMENT
Montezumas Chair
LITTLE COLORADO RIVER
FLAGSTAFF
WINSLOW
HOLBROOK
GALLUP
Puerco River
Santa Fe
PETRIFIED FOREST National MONUMENT
NEW MEXICO
ARIZONA
SAN JUAN RIVER
89
66
666
260
MILES



THE TWO BEST KNOWN volcanic necks in this region are Shiprock, 1400 feet high (*above*), and Agathla, 1200 feet high, illustrated opposite

time the deposits filling the crater were again exposed, but because they were cemented by lava, they proved to be harder than the surrounding rock, more resistant to erosion. And thus came into being one of the spectacular sights of our Southwest. The surrounding material was worn away, and the rock that once lodged in the throat of a volcano was left standing as a massive spire on the surface of a flat desert, —Shiprock, a landmark to modern tourists as it was to the early pioneers.

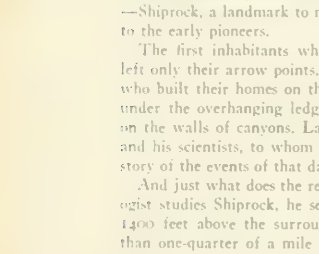
The first inhabitants who came into this region left only their arrow points. Then came the Indians who built their homes on the tops of the mesas and under the overhanging ledges along their sides and on the walls of canyons. Last came the white man, and his scientists, to whom we are indebted for the story of the events of that day five million years ago.

And just what does the record show? As the geologist studies Shiprock, he sees a tower rising about 1400 feet above the surrounding plain. It is more than one-quarter of a mile in diameter at the base, and from it radiate several narrow walls of volcanic rock, known to the geologist as "dikes." One of them, which is about ten feet in width, extends southward for a distance of more than two miles.

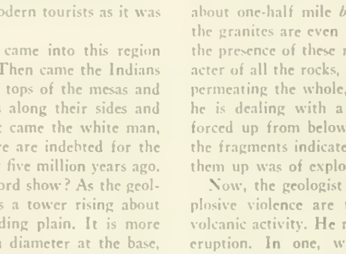
The rock itself is composed of angular fragments of sandstone and shale similar to the rocks found all about it. But besides these there are also fragments of limestone and granite rocks which do not occur anywhere within the immediate vicinity and are, in fact, only exposed many miles distant. These give the geologist a significant clue to the origin of the Shiprock. A study of the rock sequence in the region shows that the nearest limestone is actually found about one-half mile *below* the present surface, and the granites are even farther down. In other words, the presence of these rocks and the fragmental character of all the rocks, plus the small amounts of lava permeating the whole, tell the trained observer that he is dealing with a mass which must have been forced up from below. And the nature and size of the fragments indicate that the force which brought them up was of explosive violence.

Now, the geologist knows that such forces of explosive violence are the earmarks of one type of volcanic activity. He recognizes two general types of eruption. In one, which he sometimes calls the "quiet" type, the lava slowly forces itself upwards, developing a crater from which it will at times flow out over the country and roll along until it finally becomes too cool to move farther. This type is destructive only in the path of the flow. The other type,

The Beast



Montezuma's Chair



Church Rock

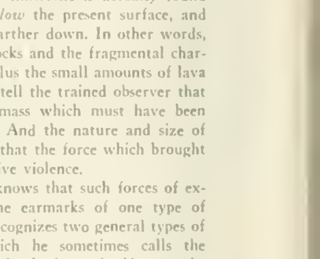
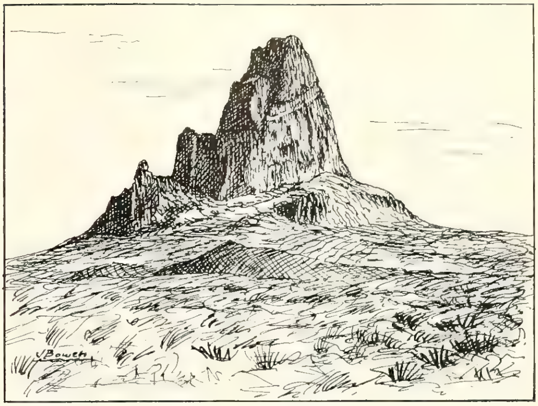


Photo by R. T. Bird



Agathla, at the entrance to Monument Valley in northern Arizona, is also shown in the photograph at the left

which he calls the "explosive" type, is one in which entrapped gasses, mostly steam, build up tremendous pressures below the surface of the earth, which eventually become so great that the overlying rocks rupture with sudden force. A terrific explosion generally results. Most of the destructive, death-dealing eruptions have been of this type. One of them was Krakatoa, in the Netherlands East Indies, which in 1883 blew rock dust seventeen miles into the air and created tidal waves that killed more than 36,000 people in near-by areas. The eruption of Mount Vesuvius that devastated Pompeii and Herculaneum was also of the explosive type.

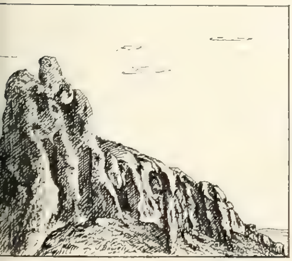
To be sure, the geologist recognizes that the explosive eruption which formed Shiprock was not on a scale of violence to be compared with those mentioned above, but the evidence is clear that the volcanic activity was fundamentally of the same type. The story, as he reconstructs it, indicates that some distance below the pleasant landscape of that day, about five million years ago, there was a great area of very hot rocks under considerable pressure. He is inclined to believe that the surface water, seeping down through the overlying rocks, became highly heated and eventually built up the tremendous pressure necessary to "drill" out an explosion pipe to the surface. The rock occupying the vent was blown out in fragments.

The explosion was so violent that the land around the vent was torn with great fractures; and the hot rocks, becoming molten as soon as the pressure on them was released, rose up the conduit and flowed between the rock fragments, cementing them together. It also filled the fractures radiating out from the vent and solidified to form the dikes.

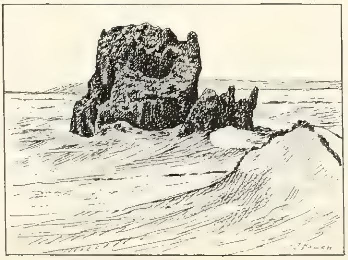
Such is the story of the origin of Shiprock, a "volcanic neck" familiar to many in what is now the northeastern corner of the state of New Mexico.

A great many similar volcanic spines in the same region and in adjacent areas of Arizona and Utah give conclusive evidence that the story of Shiprock is not unique in that region. Although Shiprock is the largest and best known of these "necks," the many others testify to the wide extent of this geologic event. They prove that this "four corners" region, where Utah, Colorado, Arizona, and New Mexico meet, and where the Navahos and Hopis today have their reservation in a land that is hot, dry, forbidding, but extremely picturesque, was once a warm, moist Eden, poised above a hell of hot rocks, whose towering remnants mark one of the largest volcanic fields in our country.

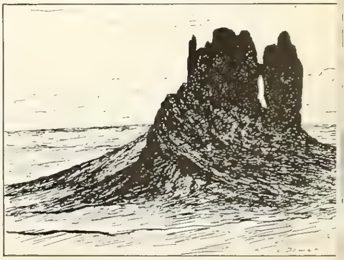
Porras Dikes



A nameless butte, near Holbrook



Boundary Butte



MANGANESE

By Frederick H. Pough

[illegible]

The ore is here but difficult to obtain—the quality of our steel depends on its production

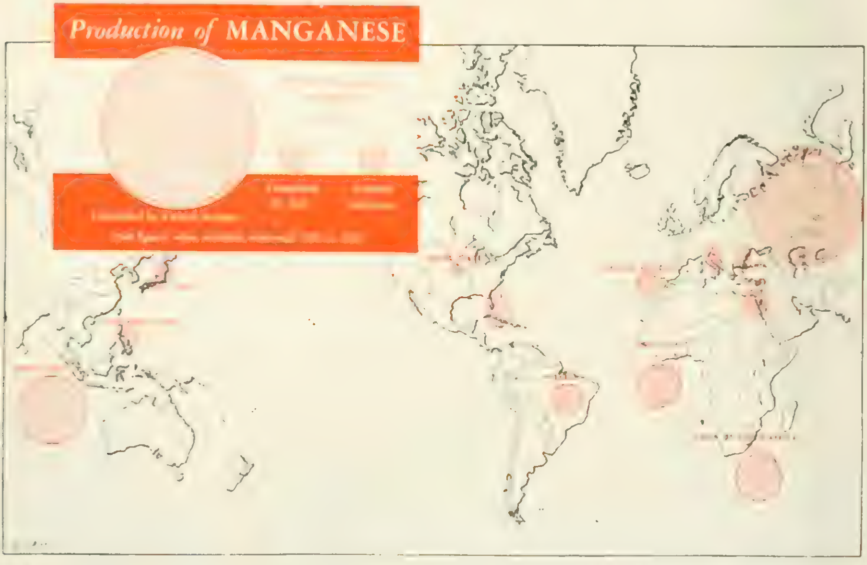
N[illegible] reasons why it is important. About fourteen pounds of manganese are essential to the production of every sin-[illegible] nese supplies are very limited. It is used in larger tonnages than any other strategic metal, for steel, steel, and more steel is the watchword of modern warfare. Yet no good substitute has been found.

Strategic materials may be divided into two classes: those which can be obtained from our own resources, if a sufficiently high price is offered; and those which are completely unobtainable within our borders, no matter what the price. Our first mineral, tin, for example, is a case of the unattainable. We could not fill our own tin needs if we offered all the gold at Fort Knox. There just aren't any large deposits of tin in the United States.

Chromium and manganese belong to the first class, which includes [illegible] quantity for some of our needs over a long period of time, and for all of our needs over a very short, but critical, period. These deposits are usually too expensive to operate in competition with imported ores. It is a popular misconception that private enterprise has been remiss in neglecting its opportunity to develop natural re-[illegible] Nothing could be further from the truth. It is regrettable that in these times an attempt should be made to delude American citizens into believing that private enterprise and private capital have selfishly imported ores which could have been produced at home.

We may take last month's chromite as a case in point. Supposing our deposits had been worked, every chromium product would have cost much more. But more serious than this is the necessity of having a supply in [illegible] not inexhaustible, every mine reaches its bottom, every vein its end. Supposing capital had foolishly exploited our deposits in times of peace. Where, now, would we fill our needs, which [illegible] years? So urgent are they that we are not considering the cost and the waste involved in getting what we *must* have. Our deposits would have been frittered away on cocktail shakers and radiator grills, we should have none to draw upon in the most critical stage in our country's history. Intelligent early planning might have built [illegible] years, but why not more sensibly leave it in the ground for this emergency?

With manganese the situation is a little different, for we need not worry [illegible] manganese resources. It has been recently estimated that one deposit alone, in South Dakota, could supply our manganese needs for many years, [illegible] manganese in sixteen per cent ore. In the past year, the Bureau of Mines examined over 500 occurrences of [illegible]



STRATEGIC METALS

NUMBER IV

ples from deposits within the United States. Ore was produced from 23 of the 48 states in 1940. So we see that manganese is present with considerable frequency in this country, and can be obtained,—for a price.

Manganese is essential to our war construction program because it is used in such large quantities in the manufacture of steel. Its role is in large measure one of purification (through elimination of sulphur). A manganese-iron alloy known as ferromanganese, which may contain 78 per cent of manganese, or more recently silicomanganese, is added to the molten steel of the open hearth furnace. A reaction takes place by which sulphur combines with the manganese, and oxygen with the silicon. If a stronger finished steel is required, more carbon and some additional manganese are added in carefully calculated amounts.

Spiegeleisen (German "mirror-iron," from its smooth fracture surfaces and white color) is a compound containing iron and manganese in low quantities and much carbon. When added to steel, it reduces Bessemer temperatures sufficiently for ingot casting and adds the necessary carbon for hardness. At the same time, it removes impurities in the form of a slag.

Thus we see that manganese is a necessary ingredient of all steels to improve their workability. The platy iron sulphide, which would form if no manganese were added, would cause the ingots to crack, even at red heat, in the rolling. By converting the potential iron sulphide to nodular manganese sulphide, this danger is eliminated, and the steel is left in a workable condition. Most steels contain only about a quarter of one per cent of manganese, though shell steels may have one and one-half per cent.

Only about five per cent of industrial manganese is used chemically, the most important chemical use being in dry cell batteries. Small amounts are used in glass and enamel, pigments, dyes, and fertilizers, and in paint and varnish driers. As has been usual with our strategic materials so far, the important uses are metallurgical.

There are several ores of manganese, most of them, from a mineralogical standpoint, rather variable in composition and certainly unattractive in appearance. One compound of manganese, the least important, is the mineral rhodochrosite, a carbonate. This often forms beautiful rhombohedral rose-colored crystals. A fine specimen of this mineral is desirable for a collection, because of its beauty. Really good examples are rare. This mineral is not plentiful enough to be mined for industrial purposes in many places, but at Butte, Montana, it occurs in abundance in more or less close association with many other valuable ores. The first step in its preparation for use is a roasting process which drives off carbon dioxide and leaves a simple oxide, practically the same in composition as the other ore minerals.

There are many compounds of manganese. It is a relatively abundant element and, unlike some of our other elements such as tin, tungsten, and chromium, it is a constituent of many minerals. There are well over 100 manganese-containing minerals, minerals in which it is an essential constituent, and many times that number in which it is present as an impurity. Manganese is often present in small quantities in calcite, a carbonate of calcium. Small percentages in the calcite from Franklin, New Jersey, seem to cause its wonderful red fluorescence; but larger percentages cause the calcite to lose its fluorescent property.

The ores of manganese, aside from rhodochrosite, are all oxides. Most of

Continued on page 237

Black knobby wad and psilomelane bear little resemblance to the rose-colored rhodochrosite crystal, but all are ores of manganese

AMNH photo by Charles H. Coles

FEATHERED FISHERMEN OF BONA

(Left) THE YOUNG GANNET IN MID-AUGUST. Its body is still covered with down and pin-feathers. These are slowly replaced by dark pinions which mark the one-year-old gannet. After three years of growth, the bird resembles its parent in every detail

[illegible]

(Below) THE LITTLE FISHING VILLAGE of Percé, with Bonaventure Island, most accessible of the bird islands, on the horizon. The massive rock projecting from the water is Percé Rock, "the pierced rock," so named for natural archways carved into it by the sea. The village of Percé is a focal point in touring the picturesque coast of the Gaspé Peninsula

NTURE

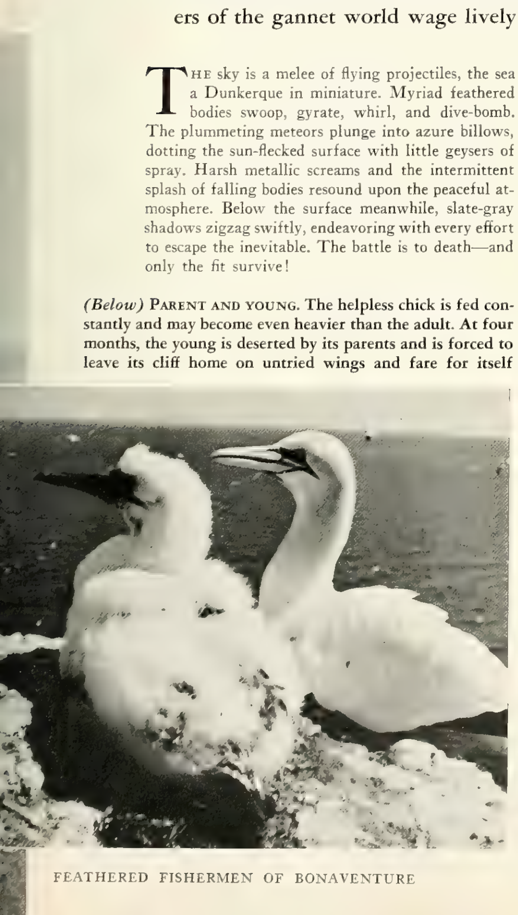
By
JOSEPH
GORDON

THE TERRACED CONGLOMERATE LEDGES of Bonaventure Island are closely crowded with nesting gannets. The cliffs are several hundred feet high, and the latest tally puts the number of birds at 7000 pairs, not counting the young

A high point in a trip to historic Gaspé, famous since the days of Jacques Cartier, is a visit to Bonaventure, near whose teeming cliffs the dive-bombers of the gannet world wage lively warfare on the life beneath the wave

THE sky is a melee of flying projectiles, the sea a Dunkerque in miniature. Myriad feathered bodies swoop, gyrate, whirl, and dive-bomb. The plummeting meteors plunge into azure billows, dotting the sun-flecked surface with little geysers of spray. Harsh metallic screams and the intermittent splash of falling bodies resound upon the peaceful atmosphere. Below the surface meanwhile, slate-gray shadows zigzag swiftly, endeavoring with every effort to escape the inevitable. The battle is to death—and only the fit survive!

(Below) **PARENT AND YOUNG. The helpless chick is fed constantly and may become even heavier than the adult. At four months, the young is deserted by its parents and is forced to leave its cliff home on untried wings and fare for itself**



The scene of this stirring contest—the eternal battle for existence—is the chill waters of the Bay of Chaleur in the Gulf of Saint Lawrence, not far from the protruding mass of conglomerate rock known as Bonaventure Island. The contestants are graceful sharp-eyed gannets and torpedo-like streamlined herring. Both creatures are perfectly adapted to their individual environments; but while the fish is eternally bound to live and die beneath the waves, the bird has some mastery over both air and water.

Success is to the quick. Swiftly do the heavy birds seize their prey and wing their way toward the rocky terraces of Bonaventure to the nesting young. Hundreds of birds, heavy-laden in stomach and beak, fill the air. A constant stream comes and goes. The island becomes a scene of moving beauty. Countless birds hover and glide above still greater numbers nesting on the gleaming red rock ledges below. Here is a patriotic symphony of color—red of rock, white of bird, and blue of water.

Bonaventure—"the island of the good adventure." Never was island more aptly named for the enterprising biologist. Yet the thought of ornithological study was perhaps the furthest thing from the mind of its discoverer. It is believed that the first white men whose eyes beheld this island were interested in ichthyological pursuits. Many historians are of the opinion that early fishermen, perhaps Vikings or other Europeans, first scanned the island in the course of their hazardous occupation of reaping from the sea. There are some who hold to the belief that the Normans and the Basques, in the darksome days before Columbus, traversed the stormy waters of the North Atlantic to fish for cod and herring and perhaps to trade with the Indians.

One of the apocryphal stories concerns one Thomas Aubert who sailed up the St. Lawrence in the early part of the sixteenth century on a voyage of discovery. He is supposed to have reached the village of Tadoussac, where he convinced the Indians of his friendly motives and then made off with one of them to dis-

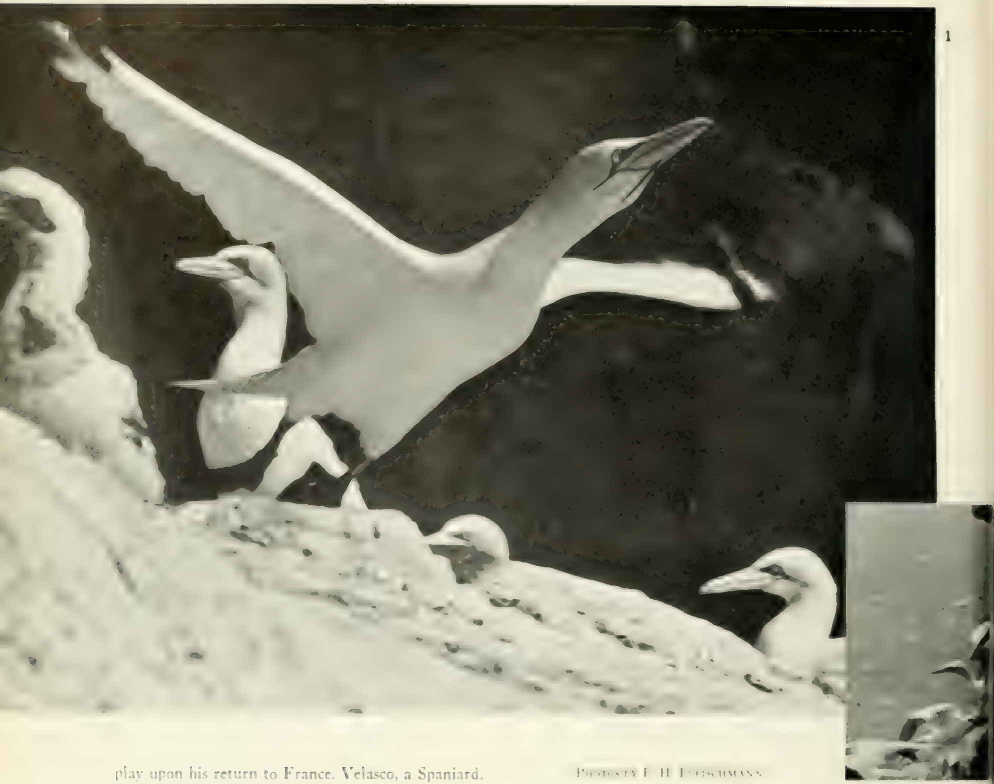


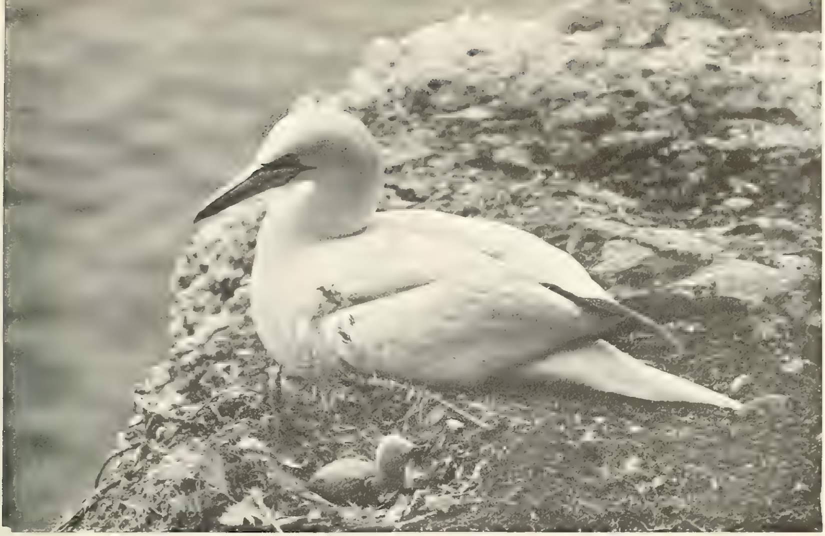
Photo by F. H. Fleischmann

play upon his return to France. Velasco, a Spaniard, is supposed to have explored eastern Canada in the year 1506. But on a map of 1520 drawn by a Portuguese cartographer, the name Breton appears, which lends credence to the thought that the fishermen of Brittany first saw these shores. Much is conjectural, however, concerning the activities of these intrepid seafarers, for none left written records or telltale remains upon the newly discovered shores.

Doughty Jacques Cartier, a Breton, is accredited with the discovery of the St. Lawrence and the Bay of Chaleur in July, 1534. His expedition was commissioned by Francis I of France, who thought to establish some foothold in the New World, along with the Spaniards and Portuguese. Leaving Saint-Malo April 20, 1534, black-bearded Cartier set the bow of his sturdy wooden craft toward the west and the Unknown. After almost a month of steady sailing, the coast of Newfoundland was raised. Sight of land, however, was short-lived, for a severe storm arose, and Cartier ran before the gale. He skirted Prince Edward Island and on the eighth day of July put into the Bay of Chaleur. Sailing up the bay, which he assumed to be the mouth of some great river, he soon realized his mistake and put ashore where the village of Gaspé now stands. Accompanied by his men and a few local Indians, he commanded a giant cross, 30 feet high and adorned with the Fleur-de-Lis, to be erected upon the spot. The surrounding land and all its environs were thereupon taken in the name of His Majesty, the King of France.

Cartier's chronicler, according to Hakluyt's translation, says that the great bird-islands in the mouth of the St. Lawrence were "as full of birds as any medow is of grasse, . . . and in the greatest of them there was a great and infinite number of those that wee call Margaulx, that are white, and bigger than any geese." Bonaventure itself is apparently not referred to here, but rather the so-called Bird Rocks in the mouth of the St. Lawrence.

Between 1860 and 1887, the population of the Bird Rocks fell from 150,000 gannets to an estimated 10,000. Local fishermen were killing the birds off in large numbers. Gannet flesh was considered good fish bait, and fresh eggs made very good eating. One of the ingenious methods for reducing the feathered population was to tow behind one's boat a board upon which a herring was painted. The bird, spotting the lure, would dive head on for the cap-



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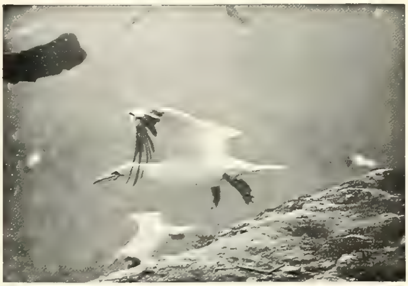

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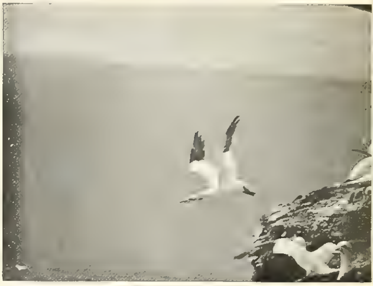


6

1. Taking off: an action photograph which catches the gannet in a posture of rare beauty

2-3-4. These photographs show the wing action of this master of flight during the first few strokes of the take-off

5. A comparison between the adult and the recently hatched chick. The chick may even exceed the parent in size before the latter deserts it at the brink of its aerial existence

6. When landing at the nest, the slightest miscalculation on the part of the parent may shove the helpless infant to sudden death on the rocks below

[illegible] Sanctuary, watched over by a guardian appointed by the government. Consequently the colony on Bonaventure has increased, and today between 7000 and [illegible] homes on its rocky ledges during the summer. The [illegible] kittiwakes, murres, puffins, razor-billed auks, petrels, and sea pigeons.

Eight Canadian families live upon the small island, deriving their livelihood from fishing, farming, and American tourists, whom they sail around the island for a small fee to view the inspiring sight of thousands of nesting birds. These inhabitants are of English and French descent and represent the last few members of a once-thriving fishing village. The younger members of the families often find it thrilling to clamber up and down the precipitous ledges hunting for stray sheep that have answered the call of their ancestors to go skipping about the narrow and hazardous trails.

The gannets arrive at the nesting ledges on Bonaventure in the latter part of March and throughout the month of April. In these northern latitudes the snow may not yet be gone. They immediately construct crude open nests of seaweed, other marine plants, dirt, straw, and moss. This mass is all matted and caked together with excrement, remains of fish, and slime. A slight concavity is left, and in this the female deposits a pale-blue, chalky egg, much soiled in appearance, and about the size of a duck egg. Occasionally two eggs may be seen in one nest, and it is believed that the second was laid by another female.

From about the middle of May, when the egg is deposited in the crude nest, until the end of June, the parents alternate in brooding the egg. Most of the "labor of love" is relegated by the more adventurous male to the home-loving female. Then comes the red-letter day when the young breaks forth from the limy prison walls to grace the crowded cliffs with its excessively ugly and helpless presence. Black-skinned, naked, and shapeless, it lies prostrate in the nest with eyes closed, zealously guarded by both parents. Within a week the white down begins to grow, the eyes open, and the helpless nestling begins to resemble somewhat its forebears. The young bird's manner of obtaining food is a trait showing definite relationship to the pelicans and cormorants. Instinctively, the young thrusts its head into the gaping mouth of [illegible] of the partly digested fish which the parent produces. The parent is able to perform this feat by virtue of a slender strip of elastic membrane extending down the throat.

[illegible] and [illegible] long has assimilated so much food that it exceeds its parent in weight and size, becoming an awkward, fluffy figure. During this period both parents must be extremely cautious in landing and taking off. The slightest miscalculation may accidentally shove the helpless infant from its insecure perch to sudden death on the rocks below. Upon returning to the nest after a foraging expedition, the parents may indulge in a bit of affection by rubbing bills. The actions simulate friendly swordplay, but at the same time definitely show signs of deep attachment between the birds. Sometimes the male may bring his mate a bit of seaweed or some other marine trinket as a gift, no doubt excusing himself for his lateness in returning home.

From June through September the helpless fledgling grows. Its fluffy down is replaced slowly by a sooty brown plumage dotted with white. Its immature wings shape out with constant flexing and extending. Then at last the young is old enough to shift for himself, and the parents desert the nest. Answering the call of hunger, the fledgling takes off with justified hesitation on untried wings and does not return to Bonaventure for up to three years.

Away from home and leading a strictly seafaring life, the young gannet molts and exchanges its darker plumes for white, so that at the end of two years the head and underparts are white and the back is dark. By the completion of the third year of growth the bird has been transformed into a golden-headed beauty, graceful as only the gliding birds can be. The wing tips are margined with funereal black, but the abundance of white gives the bird the liveliness of an airy snowflake dancing on a breeze. Its legs are webbed with heavy flaps of tissue which help both in landing upon a selected spot and in taking off from the surface of the water. Its eyes, rimmed with modernistic spectacles, are keen of sight and especially adapted for following the prey through the water after the shocking plunge.

The mature bird is a miracle and a wonder machine from the planning boards of Nature's laboratory. To see it winging overhead in measured beats, to view it diving from a height of 75 or 100 feet in a spectacular descent on partly folded wings, to observe its peculiar customs, its greetings and squabbles on the cliff, to think of the mother-warmth of the female in refusing to leave its young in peril, is sufficient reason to cause man to cogitate with deep meditation upon the infinite variety of Nature's handiwork.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Spring, 1942.

SUNDAYS over the Mutual Broadcasting System from 9:30 to 10:00 A. M.

This Wonderful World. Quiz program, with young people answering questions on nature subjects.

WEDNESDAY over the Columbia Broadcasting System Network from 9:15 to 9:45 A. M. (Central Time: 2:30 to 2:55 P. M.; Mountain Time: 9:30 to 10:00 A. M.; Pacific Time: 1:30 to 2:00 P. M.)

Lands of New World Neighbors. (New Horizons: C.B.S. School of the Air.) The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

WEDNESDAY, April 8, over WNYC from 3:30 to 3:45 P. M.

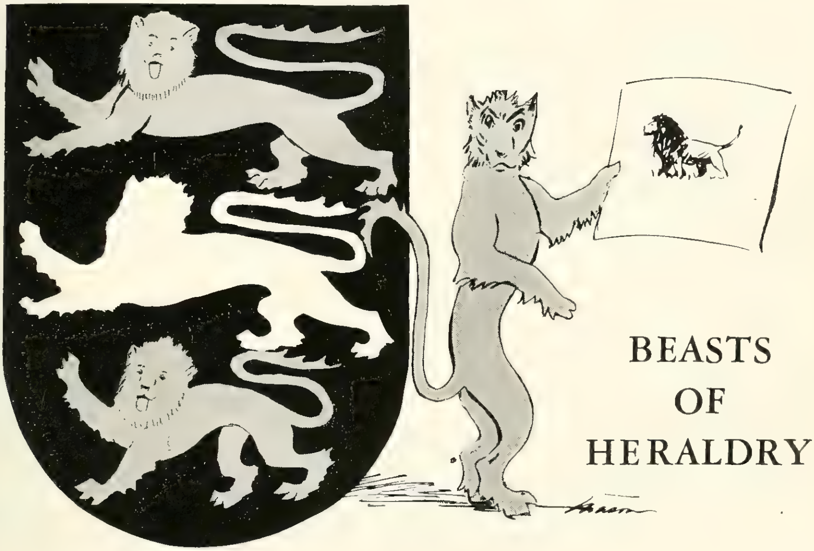
Know Your Museum: "Social Behavior in Animals."

WEDNESDAY, April 22, over WNYC from 3:30 to 3:45 P. M.

Know Your Museum: "The Recording of Bird Calls in the Field."

FRIDAYS over the Columbia Broadcasting System Network from 4:15 to 4:30 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.



BEASTS OF HERALDRY

By JOHN ERIC HILL

Drawn by G. FREDERICK MASON

IN the Middle Ages the animal most frequently represented on shields and banners was the lion. He was usually rampant, rearing up in anger; he also appeared walking on all fours, springing, crouching; sometimes only his head was depicted. The oldest known armorial seal of a medieval prince bore the Lion of Flanders, which today graces the arms of the sovereigns of Belgium and of the Netherlands. But the three beasts on the English royal arms since the time of the Plantagenets (thirteenth century) were meant to represent leopards, not lions.

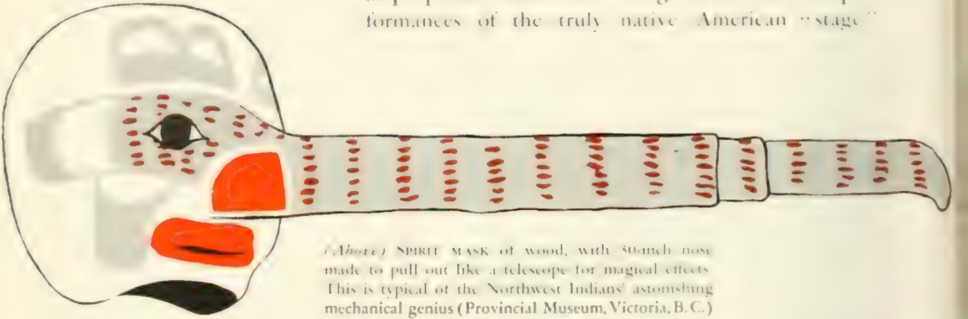
As compared with lions, few leopards appear on the arms of the period, but friend and foe alike wrote of the leopards of England. Henry V's herald was the Leopard Herald. A little over 100 years ago Napoleon's gazettes were referring to the successes and reverses of the English leopards.

The natural history of the days of chivalry was largely hearsay. A tradition then current, for instance, told how the lion had a romance with the pard, or panther, and how the offspring of this irregular union was the leo-pard. ("Leopard" is now the name generally used for the panther itself.) The legendary leopard was not described, but the heralds decided he would look like his father, the lion, but would be smaller. Size is not indicated in armorial bearings. How then would they distinguish the leopard? They decided to make him just like the lion, but as the lion always looked straight ahead or backwards in heraldry, the leopard would be shown fullface.

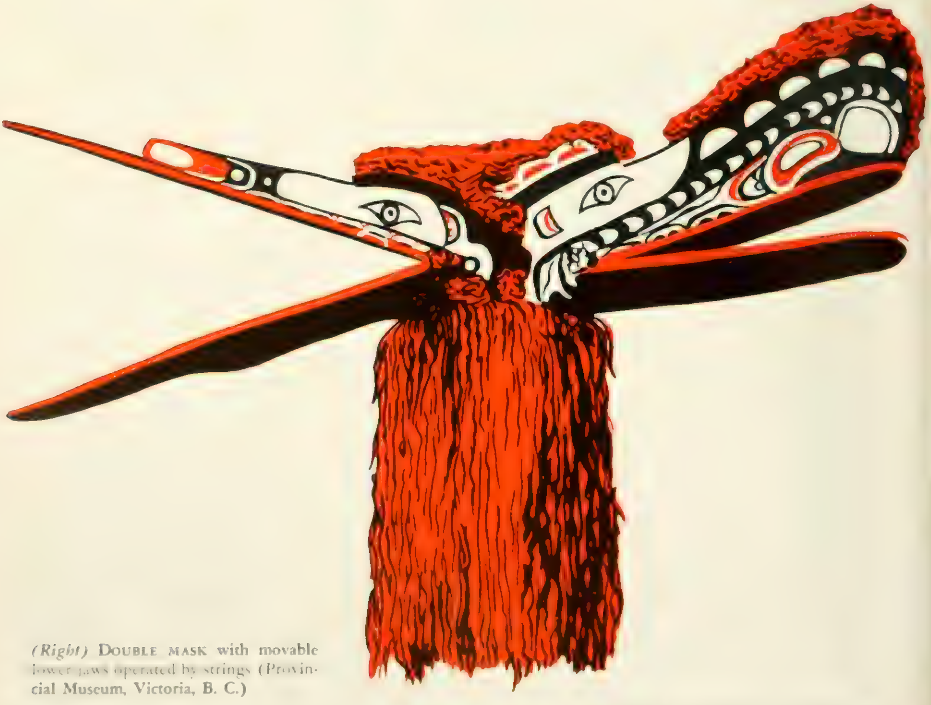
Tigers were very rare. They were represented as having the body of a starved lion and the head of a wolf; or a moustache added to the lion would make him a tiger. Other mammals were rarely used: oxen, antelope, deer, boars, bears, wolves, foxes, dogs, squirrels, and even elephants, occurred on medieval arms. In most cases better representations were made of these animals than of the lion, leopard or tiger; this may have been because the heralds had seen them.

MASKS

These strange expressions of the primitive soul served as properties in some of the greatest theatrical performances of the truly native American "stage"

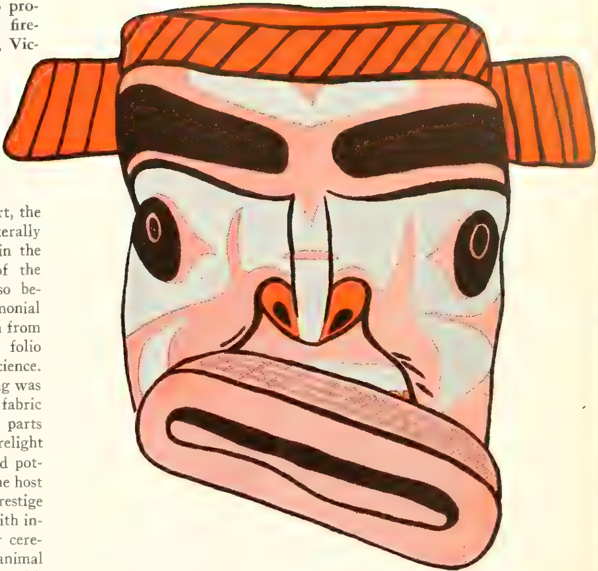


(Above) SPIRIT MASK of wood, with 30-inch nose made to pull out like a telescope for magical effects. This is typical of the Northwest Indians' astonishing mechanical genius (Provincial Museum, Victoria, B. C.)



(Right) DOUBLE MASK with movable lower jaws operated by strings (Provincial Museum, Victoria, B. C.)

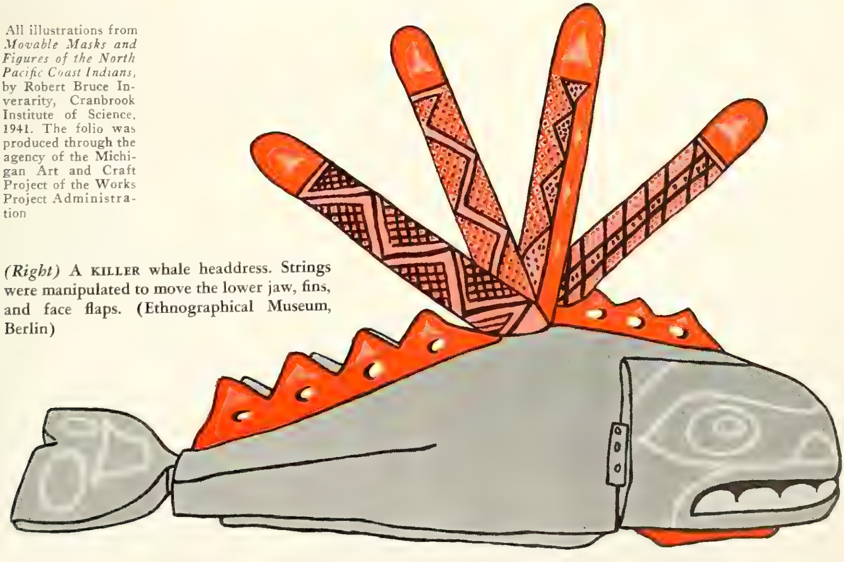
A MASK WITH MOVABLE mouth, designed to produce hair-raising grimaces in the flickering firelight of the ceremonial (Provincial Museum, Victoria, B. C.)



By raising whittling to the level of high art, the Indians of our Pacific Northwest literally carved themselves an immortal niche in the realm of esthetic self-expression. Creators of the spectacular totem pole, these tribes have also bequeathed a wealth of intensely dramatic ceremonial masks. The four examples shown here are taken from the elegant silk-screen reproductions in the folio recently issued by the Cranbrook Institute of Science.

Like most native art, Northwest woodcarving was closely woven into the economic and spiritual fabric of tribal life. Ingeniously wrought movable parts added to the weird effect of spine-tingling firelight dances performed with masks at the celebrated potlatches. The latter were great indoor feasts. The host frequently impoverished himself to gain both prestige and a horde of debtors obligated to feed him with interest when times grew lean. Climax of their ceremonies was the mystical return of ancestral animal spirits in the person of masked actors inspired with absolute belief.

All illustrations from *Movable Masks and Figures of the North Pacific Coast Indians*, by Robert Bruce Inverarity, Cranbrook Institute of Science, 1941. The folio was produced through the agency of the Michigan Art and Craft Project of the Works Project Administration



(Right) A KILLER whale headdress. Strings were manipulated to move the lower jaw, fins, and face flaps. (Ethnographical Museum, Berlin)

NOTE CONTACT with the outer world. Once a week, the "swamp truck" (above) transported provisions across a 40-mile cordon of trackless marshland

(Above) ROLLING through Big Cypress country

(Above) THE FAMOUS TAMIAMI Trail: the only road that cuts across the Everglades and Big Cypress country in an east-to-west direction

A lady ethnologist and her two children penetrate Everglade jungles to learn the ancient tribal ways of the unknown Seminoles, an example of what unique adventures await explorers in their task of rediscovering America

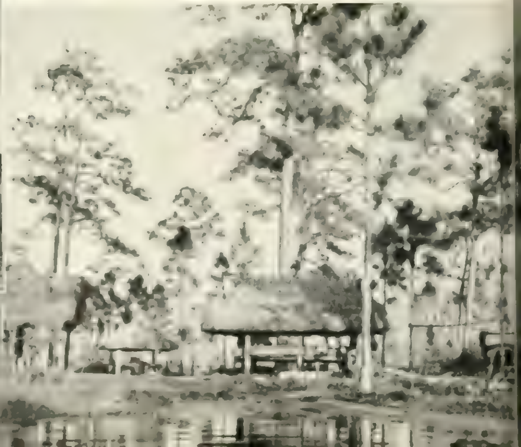
WHEN THE [illegible] and were at [illegible] now the [illegible] through [illegible] trackless wilderness that separated us from the nearest road and civilization.

I was too elated to mind the shy scrutiny of the Indians. [illegible] of discouragements, I was finally arriving at the goal towards which I had been striving. I would do what no scientist had yet done. I would live among these people in their own environment long enough to be their friend, to share their daily life and see their customs unfold unselfconsciously around me. The truck came to a final halt.

"Your wish is granted," called Mr. W. Stanley Hanson, the government representative in charge, as with a flourish he flung open the gate to the Big Cypress Seminole Reservation, in the heart of the Everglades. And my wish did come true, for the next year I brought my children with me and we took our place in the Indian community as another family, another camp to be visited and other children to be played with.

For a number of years I had been working in anthropology. Because my winter home was in Florida, it was logical that I should center my interest on the near-by Seminole. Dr. Clark Wissler, Curator of Anthropology, approved of my plan, and in 1938 I began my association and research work with the

(Below) NOT SAMOA, but a typical thatch-roofed village i Florida's Seminole reservation. These *chi-kis* afford more privacy than their open walls would indicate. Erected on stilts, thei "floor" comes within a foot or two of the overhanging eave



(Left) THE "NEW GIRL." Cocky Freeman, 14, found it no harder to break the ice among the Seminoles than in any other new neighborhood

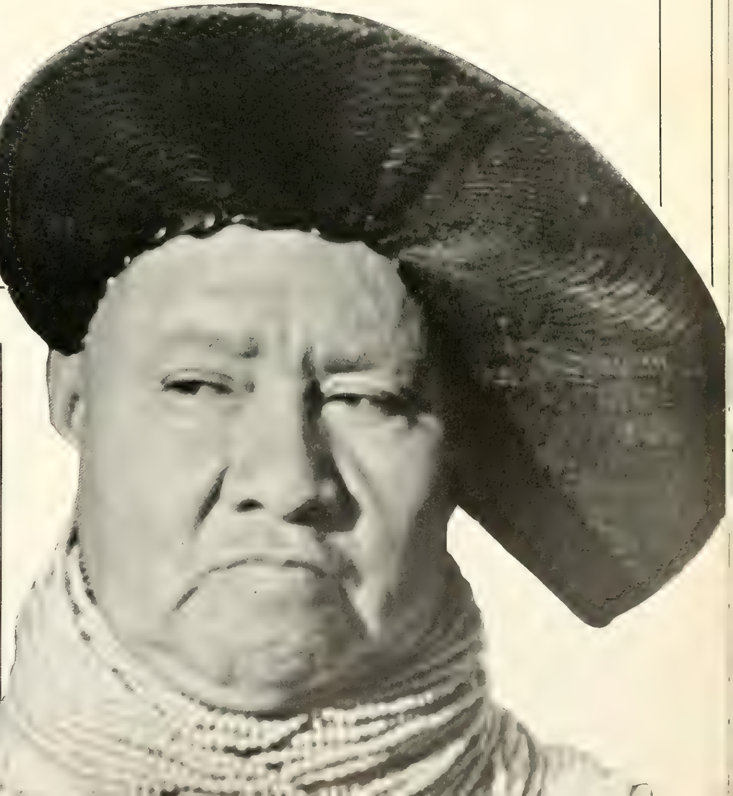
(Right) AUTHOR and Seminole braves. Comradery soon displaced the hostility they felt at first

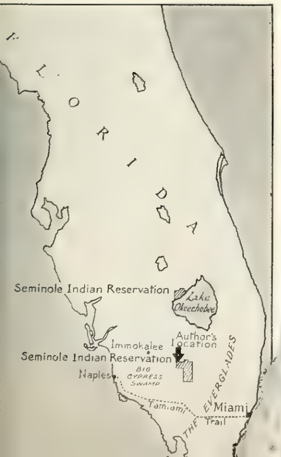
(Above) TWELVE-year-old Leon Freeman and his Seminole pal, Billy-Buck, at rest on a wild oak

ALL PHOTOS BY THE AUTHOR

We live with the SEMINOLES

By
ETHEL CUTLER FREEMAN




FLORIDA
Seminole Indian Reservation
Lake Okeechobee
Author's Location
Immokalee
Seminole Indian Reservation
Naples
BIG CYPRESS SWAMP
THE EVERGLADES
Tamiami Trail
Miami

[illegible]

[illegible] unknown people living in an unexplored wilderness, [illegible] ple were the Big Cypress or southern group of the Seminoles. They are among the most unapproachable and least known Indians in the United States. The wild swamp in which they have their palmetto-[illegible] months of the year. It is about one-third again as large as the state of Connecticut and, roughly speaking, stretches from sophisticated Palm Beach and the coastal fringe of towns on the east to Key West on the south and Fort Myers on the west. Only one road cuts across this expanse east and west. It was into this morass that the Indians fled when resisting deportation to Oklahoma during the Seminole wars of the 1800's. Now with a belated twinge of conscience, the government has set aside this land for the Seminole's exclusive use.

This limestone saucer, filled with the muck of decayed vegetation, is tipped slightly to the south, where the water brims over. There are no stagnant pools in the Everglades. Within the cypress heads, strangler fig, festoons of wild grape, orchids, tree ferns, and air plants crowd for space where sunlight barely filters through the heavy foliage. Here, water stands knee-deep, and many cottonmouth moccasins make this their home. Their menace was never forgotten by the Seminole as well as the white man. At all times the Indians watch for signs of danger, but in this, as in other things, they are not aggressive. They do not kill the poisonous snakes, but avoid them. I was likely to see several wriggling forms between my tent and the Indian village a hundred yards away. Some of these were cottonmouth moccasins, big fellows five or six feet long. In the cypress heads they were as numerous as eels in a tank.

"Do you know the origin of these Big Cypress people," I asked Mr. Hanson, as I watched the arrowhead-like ripples where snakes swam calmly on their way. I was hoping for local information not found in books. "No, I guess no one does, really, unless the Seminoles know it themselves, but they won't talk. They speak a kind of Mikasuki dialect, and so I figure that they must have come from southern Georgia where the Mikasukis lived." Mr. Hanson looked thoughtfully at one dark-skinned Indian. "Maybe some of these married the Calusas, the fierce Indians who were found in southwest Florida by the Spaniards long ago, but sometimes I suspect that they have many wild strains of blood. Mr. John Collier, Commissioner of Indian Affairs in Washington, said that 'they were gentle but wild,' and he was right."

"What of the Cow-Creeks around Lake Okeechobee?" I asked.

"Oh, they're Creeks and speak Muskogee," he said, uninterested. "We know all about them. The two branches of the Seminole don't mix and don't like each other."

"Is it true that the Big Cypress teach their children that we are beasts and bring evil to them if they so much as look at us?" I persisted, for he was brought up among them as a favored individual and [illegible]

"Why wouldn't they," he countered. "We captured their great warrior, Osceola, under a flag of truce and threw him into prison. We gave a bounty [illegible] alive. Would you like the people who hunted you like animals through the Everglades? The Seminoles are still afraid of the government. They fear spies, for they believe even now that we want to catch and deport them."

"I can't speak their language," I said, looking at the Indians to see whether they seemed suspicious. "How will they know that I want to aid, not harm them?"

"They do misunderstand, often," was his disconcerting reply. "They believed that dead men's spirits hovered around some army blankets that I received, and I could not make them understand that they were new blankets and harmless. They were much excited about it."

As we were crossing the Everglades on my first trip, these strange and ominous attitudes were foremost in my mind, and so it was not surprising that my heart was beating like a trip hammer in anticipa[illegible] adventure. It [illegible] even faster before my trip was over. Here I was in the Everglades, out of communication with the outside world. My companions were one white man, many Indians, and a sixteen-year-old Florida girl, who was the only person I could hire to come with me. I had never seen any of these people before the day of my arrival. What lay ahead? Where would I live and what would I cook on? But most important was the doubt: could I make the Indians understand my real friendliness toward them? Could they believe, in spite of their past experiences, that I had no ulterior motives in coming among them? No one had been able to tell me about conditions at the Reservation, for few people had been to this remote spot. We had left the last white people at the outpost town of Immokalee, which means "My Home" in their language.

As we crossed the Everglades, none of the Indians thought of discouragement after hours of grueling work. "Chi-ko-li-set" (Sit down), they would laugh among themselves, as we bounced like popcorn on a hot griddle. Or they would clown about their inability on foot to overtake the crawling truck, joking "Mon-ka-shai" (Wait a minute) as it yielded to their pushing and crept through the mire. Each was still gaily alert to do his share. Already I felt the strength of their indomitable spirit, which overcomes all obstacles not by aggression but by co-operative intelligence. This struck me forcibly, for I was sore and tired from the hard trip when, long after dark, the swamp truck came to a final halt.

I could see the flickerings of eight or nine campfires through the cabbage palms and pines. A typical Seminole village, like a stage setting, stood so close to me that I could almost touch a *chi-ki* with my hand. The central fire under its roof of smoky thatch, illuminated the tropical trees and the clustering *chi-kis*. The women and children in their swaying skirts made splashes of vibrant color as they carried the food to the eating platform for their men, who were just arriving. It was a dramatic picture of a people unspoiled by white contact, still leading their old native life.

The lights of the truck shone on Mr. Hanson's small white bungalow in its neat enclosure. "I've turned the storeroom into a bedroom for you and Delia," he apologized. "I'm afraid that you won't be comfortable, for I have only an upturned orange box for a dressing table."

There were no conveniences in the house. We drew water from the pump under the guava trees in the yard and we cooked supper on a kerosene burner that looked like a chafing dish. "By the way," Mr. Hanson said casually, "you had better hang your clothes over the window, because two Seminole men have volunteered to sleep on the porch, just outside, to be ready in case of need. But we are safe as a church." Mr. Hanson added hastily.

Not without visions of Indian massacres, with the two faithful defending us from the other savages, I got out my bedroll, and Delia and I were soon asleep.

The next morning I awoke with the impression that some bird had called a few feet from me. Wild turkeys had run ahead of us the day before. Ibis, heron, and egrets had risen in great flocks to settle a short distance away. Sand-hill, whooping crane, and limpkin had looked at us from near by, and I wondered which of these birds would make this strange sound. The call was again repeated from several locations. It lingered eerily.

"How did you like your alarm clock?" Mr. Hanson grinned, as we appeared. "Did you think that you heard birds? The Indians were calling to waken you."

Later that morning I was sitting outside the enclosure, where I could see the thatched roofs of seven villages and the bustle of life in those close at hand. I heard again the clear bird-like tones and, looking up, saw a figure coming toward me. Sho-ki,* age fifteen, swung along with his head thrown back and a band of bright beads fastened charioteer-wise around his smoothly oiled hair. He was blowing through cupped hands, using his fingers as though playing a flute. He was signaling to one of the villages, perhaps telling them that I was there. That evening, as Delia and I walked out in the moonlight, a calling was immediately set up between the camps, and dark forms came out toward us. We beat a hasty retreat.

I had read in the old books that the Indians communicated by bird calls when they were attacking during the Seminole wars. When I was wakened in the dark, several mornings later, by peculiar urgent and excited high staccato notes, I was worried. They seemed to be relayed from near to far village, back and forth, and ended in a kind of turkey gobble, as I had been told they always do. The day before I had visited many of the villages for the first time. Did they suspect me? Were they saying, "How will we get rid of the spying woman?" I lay on my cot and listened and held my breath. After half an hour the bird notes ended. Later I found that one of their tribe had been arrested for drunkenness and was in jail. Presumably they were spreading this news; but I do not know their method, nor does anyone else, I believe.

The first morning after my arrival I wanted to meet the Seminoles who had just wakened us in so novel a fashion, and I followed Mr. Hanson out after breakfast. The Indians were coming into the enclosure, and I said 'Hon-tam-o" (How do you do), as they walked by. Though a white woman in the Everglades was an unusual sight, they passed me without a glance. A young woman came in with her baby astride her hip. "Hi-li-ga y-a-to-si" (A healthy fat baby), I ventured, reaching for the infants' hand. But the child clung to its mother in fear, and the woman turned her back on me abruptly and walked quickly away.

Mr. Hanson beckoned me to join the group who had ignored me so completely and introduced each to me by name. Every man looked me directly in the eye as though trying to read my inmost thoughts, and shook hands solemnly. The woman and child now sauntered over, and her husband spoke to her in Seminole. She turned around, looking at me shyly, smiling. I was accepted by them, because their white friend vouched for me. This was the beginning of my friendship with the Seminoles, thanks to Mr. Hanson, the only white man who has their love and confidence.

I felt that I was just beginning to get beneath the surface of the lives of the Indians on the Reservation and the Tamiami Trail during my first visit of five weeks that winter.

That year of 1939 was the period of the great fires in southern Florida. I was not there at the time, but the papers all carried reports of barren, blackened stretches, where fires had raged, and animals and birds had been driven 200 miles north from their regular haunts beyond the Everglades and Big Cypress swamps, to the far side of Lake Okeechobee. What had become of the Seminoles who lived in this area? Had their camps been burned? None of the accounts mentioned them. How did they feel toward the white man, who by drainage of their land had now added another tragedy to their lives? All of these things I wanted to know. It also seemed important to consolidate the friendship that had been begun between us, before they had forgotten me. So in April I returned for a happy and profitable month, finding that few of the villages had been damaged, and none seriously.

In February, 1940, I believed it feasible to bring with me my daughter Cocky and son Leon Jr., age fourteen and twelve respectively,—if snakeproof leggings and antivenin were part of our equipment. A tutor solved the school problem, but the firsthand contact with people of different and often more idealistic and unselfish values than our own was to teach us more than we could learn from books.

Again we had arrived long after dark, in the rain; and towards midnight our five tents were battered by the tail end of a hurricane. I would have been happier had I known that the Indians, used to storms, had cut down good-sized cypress trees and had placed them, like their *chi-ki* posts, four feet in the ground so that our tent ropes would be secure. The smell of coffee and sizzling bacon the next morning was comforting.

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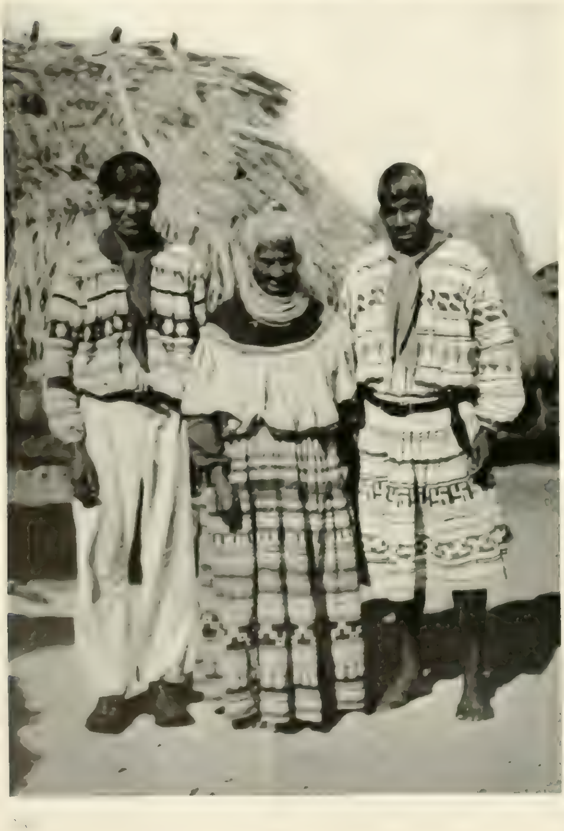
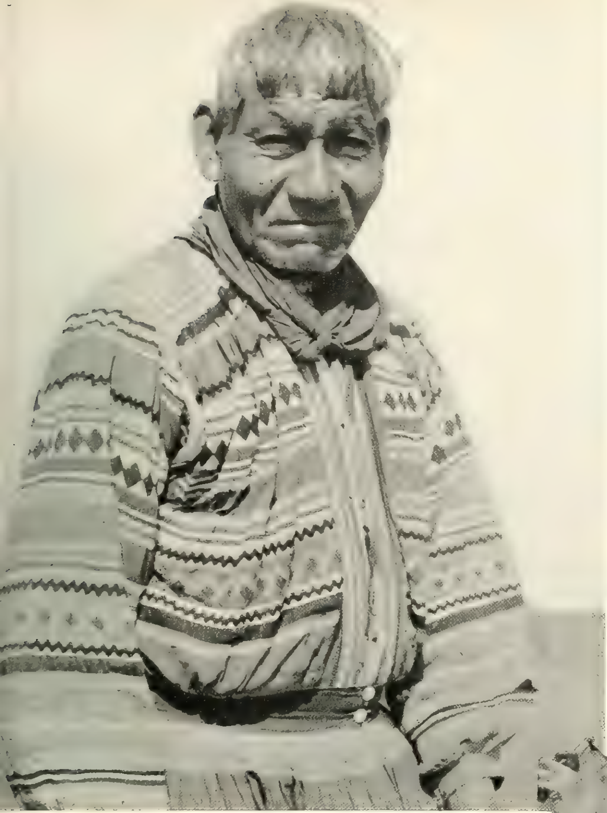
*The Indian characters have true Seminole names, although they are not their own.

(Left) SEMINOLES call on us

(Above) SPEARING nonpoisonous snakes. Billy-Buster, in the foreground, lunges with lightning speed, while Leon Freeman tries to learn the knack. Billy never missed. After the snake was killed he made a curious ritual of washing his hands for several minutes

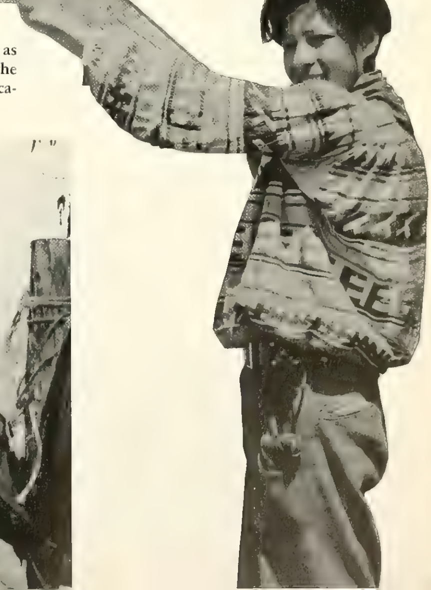


THREE GENERATIONS of Seminole fashion *(left)*. "Old Woman" is over 100 years old and wears the dress and hair style of her youth. The man at right is of her children's generation, the one at left, of her grandchildren's

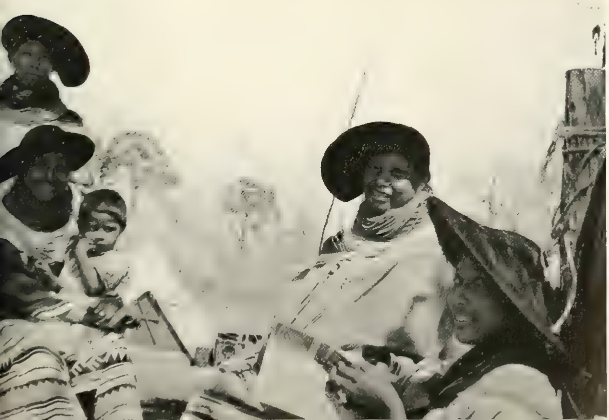


This old man's dress is made in one piece and belted at the waist like a Russian tunic. It hangs to slightly below the knees

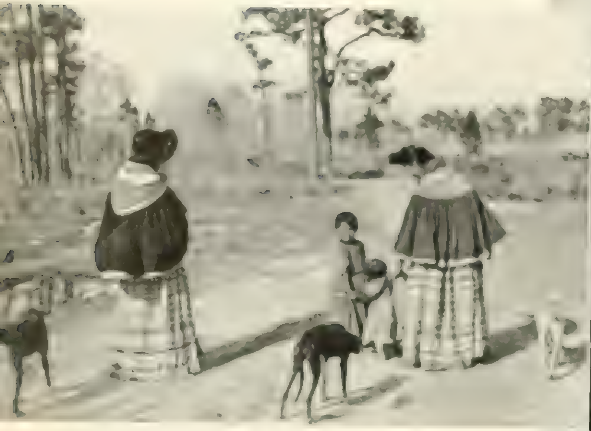
Trousers are worn by young Seminoles, like the one below, at the request of white society. When hunting during a wet season he is clad only in his long-tailed, gaily ornamented shirt, but he doesn't dare journey to town without pants



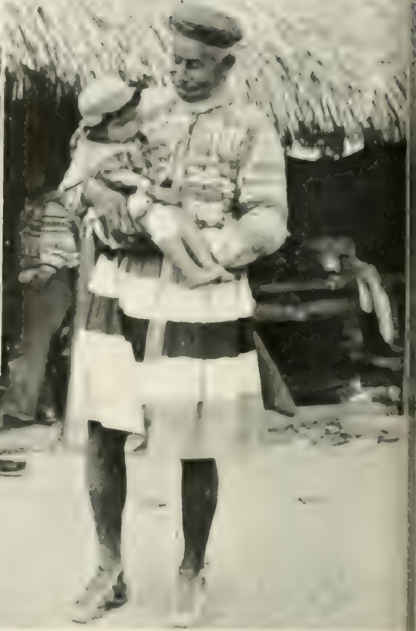
The distinctive headdress of Seminole women is practical as well as artistic. The hair is smoothed over a cardboard frame, which keeps the sun out of the eyes. The mirth discernible in their smiling faces is occasioned by the author's early efforts to learn their language



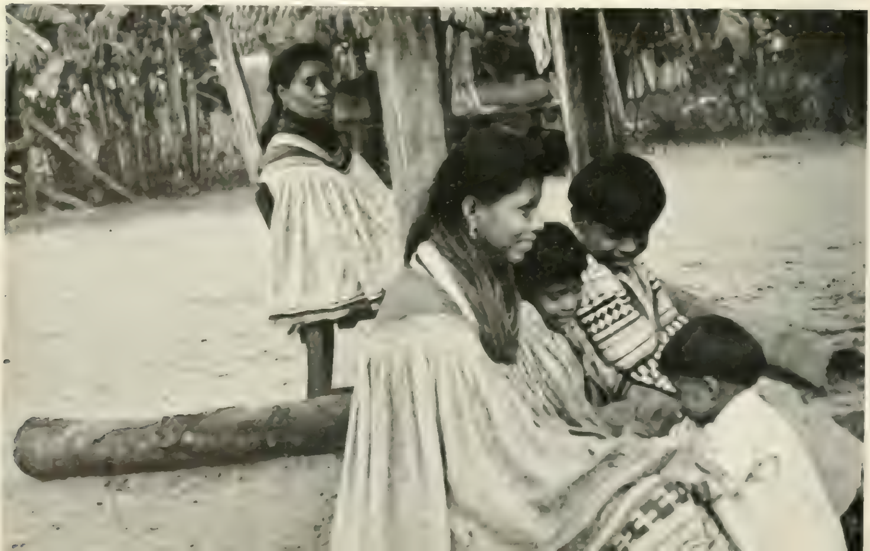
(Right) THE OLD MEN are affectionate and gentle with the little children



(Above) WOMEN'S SKIRTS are gaily colored and startlingly beautiful. Traders supply Seminole women with lovely shades of bright calico, which are manufactured into the finished product on a hand-driven sewing machine



ELDERLY SEMINOLES are conservative and aloof. The old woman remains in the background because she is still undecided whether the white visitor is her friend



LIVE DOLLS are the daily concern of Seminole girls of eight to twelve years. If there is no sibling, the older sister's child is often cared for, much to the delight of these "little mothers"

(Below) CURIOSITY. Seminole children are continually with their elders and take their attitudes and interests from them

(Right) A SEMINOLE WIDOW weaving a basket from special grass that grows only in a certain district of the Big Cypress country. Now that game is scarce, the tourist trade in souvenirs is becoming increasingly important

[illegible] down on us like a ship under full sail, her volumi- [illegible] Over her head she held an enormous palm leaf, so [illegible] an umbrella, although the rain poured off its tip like [illegible] home in New Jersey and by his unselfish devotion helped make Leon's recuperation bearable.

The sun had come out, and I looked towards the horizon, across a vast grass-tufted, shallow lake. In it the vivid blue sky and white clouds were so clearly reflected that an Indian and his wife who came through the water seemed to be wading in the heavens. They had been forced to seek refuge on a higher hammock during the rain and high water.

The woman's skirt was held above her knees out of the water. The back of the man's head was shaved behind the ears, making a straight ridge of long hair around the front of his head. He carried his prized and well cared for twelve-gauge shot gun. Canvas packs slung across their shoulders, contained most of their possessions. They too passed me without showing that they were aware of my presence.

But two boys, one about Leon's age, whom I had known the year before, came over to get acquainted. Na-wa-ki's shirt was not made of as many tiny pieces, because his mother was dead and I had seen him that very morning finishing it and trying it on.

Two other figures, slinking furtively behind them, looked like scarecrows. They were caked with dirt from head to foot, their hair was matted and their clothes so rotted that even the safety-pins could hardly hold the snagged pieces together. I was told that the wife and mother of this pair had died and that during the season of mourning they could not change their clothes or wash and they must avoid human contact. A few days later I saw them dressed like any of the other Indians.

Our breakfast was hardly cleared away when old friends began to arrive. As-hi-gi was very pretty in a new dress, and straddling her hip was her child.

I wanted to enter into their conversation and life. I found it surprising that we could convey so much to each other without words. As I look back, I can appreciate some of my funny mistakes, at which they laughed merrily, but their enjoyment was never derisive. I was trying to say, "I said something to make her laugh (Ah-ni-a-pon-la-li-gone-at-so-bi-la-so-ungus); but instead said, "I said something to make her leave her husband." This was greeted by subdued shouts of joy.

The winter of 1940 was cold and raw and it rained continually. We slept under five blankets, generally doubled for warmth. We wore two sweaters under our heavy overcoats and wrapped our legs in steamer rugs. The Indians suffered too and looked bulky in blankets and extra shirts. But one day it turned unusually warm. We were sitting in the Florida sun at A-lish-a-la-ki's village. Ne-hi, an unmarried cousin, was arranging her hair, and there [illegible] Seminole's hairdress. First Ne-hi pulled her hair to the top of her head in a switch, and tied it at the base. Then came the curious cardboard frame, which is shaped like a large hat brim and is certainly an adaptation of the white woman's hat. This is covered with black cloth and wired at the edges. The shy Ne-hi pulled her hair smoothly over this and covered the whole with a net made of black thread. Finally she decorated the edge next to the forehead according to individual taste, with loops of beads and bright pins.

After Ne-hi had finished arranging her hair, a handsome young blade, tall, spare, and broad-shouldered, came around the *chi-ki*. The young girl was consciously unconscious. She pulled her hair brim coquettishly down over one eye and peeped coyly out from under it at the young man, using it as flirtatiously as any young lady of the Gay Nineties ever used a fan. The young man came and stood near her, half-turned away, making no direct advances. Her clear, café-au-lait skin colored with pleasure, and she cast winsomely demure glances at him—which were not wasted, for she married him at the Green Corn Dance not long after.

One night the next year about six o'clock I went to Ne-hi's mother's village in the Everglades, not far from my camp, and saw the *chi-ki* that Sho-pa-tsi had built for Ne-hi when he married her. The village was large and important, having about ten *chi-kis* where the individual families of the clan lived, with sometimes a *chi-ki* for the children as well, for as they grow to 'teen age they live in separate huts. When I approached the new *chi-ki*, I could not see that anyone was on the platform until I was close to them. Apparently they had not heard me. The husband had bathed, put on a new Seminole shirt, and his beaming black eyes were looking lovingly at his wife as he lay with his head in her lap and she affectionately stroked his hair.

That evening, Not-so-ha-e-tchi, a young council man, broad-shouldered and responsible, came to see us, followed by his new wife of sixteen, pretty and sweet and adoring. He was very much in love with her too, and showed it as obviously as any infatuated white boy. The people are merry and playful and they laugh and joke and make a game of everything.

One evening shortly before sundown, while walking through a path in the 'Glades, I came upon a pretty sight. The water was breast-deep in a pool, and here the women came to wash their clothes. As-hi-gi and her sister had soaped and scrubbed the family laundry on a log. As I watched them, As-hi-gi took the last wet skirt, drew it over a selected bush of the right size, where, presto! it would dry as smooth as though ironed. Two nude boys of about sixteen were with them, and they were all laughing and splashing each other, as As-hi-gi's small child looked on from the log where it perched. As I did not want to intrude or have them suspect me of spying, I quickly retraced my steps.

I was to learn that it was difficult for us to keep ourselves and our camp as tidy as did our Seminole neighbors. Differences in customs sometimes cause misunderstandings. Soiled pots here did not denote negligence but cleanliness. The Indian considers us the offenders, for we cook in pots that have been washed for several hours and must therefore be dusty. He washes his utensils just before he uses them.

It was a few mornings after this that I realized that something exciting was going on at the Tiger Camp, so I went over. Everyone was bustling. The fire, laid like the spokes of a wheel, was blazing in the middle of the morning, and Mrs. Squirrel Jumper was grinding corn. Around the fire, eight gophers, or land turtles, were cooking. A little boy was sitting on one of the logs stirring something that bubbled in the deep fat, like yellow cherries. Everyone was as pleased and excited as our children are during the preparation of a Thanksgiving feast.

Many Indians began to arrive from the various villages. None brought any food with them, and Mrs. Squirrel Jumper had much grinding to do. All were dressed in their best.

Several gay young women left the village and sauntered past the five young men who were standing just inside the fence. They smiled, looked sideways coquettishly, and the men returned their glances, laughing among themselves, just as white men and girls do on our country street corners. Suddenly they subsided meekly, for their chaperone, the large and dignified dowager, Mrs. Buffalo Cypress, came steaming along like a battleship. She looked neither to right nor left. Beautifully and correctly dressed, old Mrs. Grundy herself was seeing that her charges walked the straight and narrow also.

It was a great occasion, for Mrs. Squirrel Jumper, one of the old conservatives, had come to call. Cocky was making fudge in the cook tent. Leon, smelling something good and wanting to tease his sister by way of diversion, rushed in and grabbed some candy. A battle royal ensued, with Cocky as victor, and Leon spun out of the opening, hands and legs flying. Astonishment, incredulity, and arrested fear were expressed on the amazed faces of the women and children. I have never seen any quarreling or slapping nor heard any raised voices or bickering, either among the children or their elders, in the three winters that I have lived intimately among them. An effusive person is as undesirable in their eyes as a shouting, backslapping man would be in ours. No one impinges on another. Personality and time are individually owned.

After this episode, Mrs. Squirrel Jumper appeared more doubtful about us than ever. As Cocky moved around the camp, the boys' eyes followed her. One could see that they were wondering about her blondness, her curly hair, her little freckled nose, and her blue eyes that looked at them so frankly. She smiled as she brought over the pan of fudge to them saying to me, "I thought that this would help us to be friends." The Indian boys were bewildered and did not know what Cocky wanted them to do, so she put the pan into their hands and made signs for them to eat the candy. They took it, placed it on a log and talked about it together, then looked at it again, smelt it and felt it. Knowing a few words from the year before I said, "Im-pi-ki" (eat). With that, they took a little piece gingerly, but as soon as it was once tasted, it disappeared in a jiffy.

You must not imagine that the Seminoles accept food or presents without trying to repay the kindness. The night after the boys had eaten with us, the older brother brought me the heart of a palm tree, and As-hi gi and her little daughter brought me a big canvas, which we excitedly unwrapped and found to contain some lovely flowering plants.

I was very much pleased, for I felt that we really could understand each other and that after all, Judy O'Grady and the Captain's lady, be they brown or white, are really all alike. But that very evening I had my doubts. I had been conscious that we were being watched. Remembering past history, I found it hard, after supper, to concentrate on the notes that I was writing up, for in the dark I had often seen the form of a man slither behind a mango tree that stood just outside my sleeping tent. This particular night was very black, and going to Leon's tent to kiss him good night, I was watching for snakes, as usual, walking with my flashlight, when suddenly I felt someone. My arm was seized and something thrust into my hand. The person disappeared. I had not heard him come or go. Trembling so that I could hardly turn the light, I saw that a bunch of rare exotic flowers from way back in the Everglades had been given to me. Later I learned that one of the older boys had gathered them and, perhaps being too shy to give them to me in front of the others, had chosen this terrifying manner. After this expression of good will I felt more confident.

How have these people acquired such gentleness and sweetness? What has taught them such honesty that money, food, or candy can be left where it is easily accessible and not be touched? Can the wise disciplining of their children be responsible? The babies are with their mothers continually and are surrounded by love and the security of knowing that they are wanted. Corporal punishment is administered to the young by a representative of the group. It is impersonal, and there is no individual resentment. Yet property is owned individually, even by the child, and his behavior is his individual responsibility to the group.

As-hi-gi's toddling baby upset a box from one of my chairs. The ensuing crash frightened her, and her face twisted to cry, but the mother caught her up to her breast, cuddling and crooning, comforting and nursing her until she slept. As-hi-gi does not always cuddle her child when she cries. If she receives some slight hurt or is thwarted in what she wants to do and runs crying to her mother, As-hi-gi will not reprimand her but will look off in the distance, seemingly unconscious of the child's existence. This attitude will persist as long as the baby continues to plead and pull at her skirts. Even here there is no aggression on the adult's part.

Julia, age five, was taking me to her village to see her make her doll's clothes, for the very young girls can sew well on the hand machine. She was running fast when she tripped on her long skirts and fell hard. It must have been very painful, and I rushed to her saying, "Oh, are you hurt?" She picked herself up, laughing to cover her discomfiture and shook her head violently, and to prove that it was nothing, she threw herself with all her force headlong on the ground again. No wonder these people had the fortitude to withstand us during the Seminole wars.

We felt great admiration for these people. Their [illegible] of which the Big Cypress are proud.

[illegible] and seen boys walking with their arms thrown over [illegible] Cocky happily running and jumping with the Indian [illegible] aware that we had learned an important lesson that [illegible] unlike ourselves had given us a real sympathy and deep affection for them. The words "truth," "sincerity," and "integrity" took on new meanings to me [illegible] spiritual values made our popular words, such as, "material possessions," "ulterior objectives," "expediency" and "propaganda," seem sordid, indeed.

It was during the last part of April, some time before we had expected to come home, that the accident occurred which proved the real affection and interest that had grown up between many of the Seminoles and ourselves.

It was half past six and Cocky and I were hurrying to get supper. Suddenly I heard the most terrifying screaming, and Leon Jr., like a flaming torch, [illegible] turned the gasoline can on himself while trying to light a lantern and had caught fire. I had no time to snatch up anything to wrap around him. I had to [illegible] and squeezed out the fire, some way. I like to forget the horror of his pain, and that night. The con- [illegible] lovely. I did not know until afterwards, that Not-so-ha-e-tchi and many of the others stayed outside our tent until very late, and they were there again early in the morning helping pack and lifting Leon gently onto the air mattresses and pillows. His playmates hung over the side of the truck and looked at him with unmistakable affection and solicitude, and as we pulled off across the swamp and I waved my two hands, bandaged like baseball mitts, to them, every Seminole took off his hat and waved it until we were out of sight.

We had asked Mr. Hanson to drive one of our cars home for us and bring Fa-hi-ha-tchi Cypress with him, for a short visit.

Two weeks later, in the hospital in New York, Leon with quivering lips, swallowing hard and, trying to control his shattered nerves, choked, "Mummy, can't the doctors understand that I must be home when Fa-hi-ha-tchi gets there? Everything will be so strange to him." Leon looked around the room. "Why, he's never lived in a house, he doesn't even sleep in a bed or eat at a table."

But the skyscrapers of New York, the crowds of people after the solitude of the wilderness, the curious stares of strangers attracted by his shamrock green trousers and gaily patterned blouse, the elevator, like a room that suddenly flew skyward,—all these had not existed for Fa-hi-ha-tchi until he saw Leon.

With two strides, the Indian had crossed the little white hospital room and with the protective tenderness of his 23 years for a little sick fellow whom he loved, he sat contentedly by his bedside as though guarding his playmate from future harm.

THE GREAT ANIMAL INVASION

ica and, by analogy, to fill in some of the interpretive gaps left by incomplete factual knowledge of that earlier event.

This is what happened: the great Mesozoic dinosaurs and other -saurs also disappeared in South America at the Great Dying Time, and the Cenozoic started there, as in North America, with the appearance of the varied archaic mammals of the Paleocene. Then South America was isolated by the sea and it became an island continent. The modernized Eocene invaders of North America could not reach South America, and while the archaic fauna was fighting a losing struggle in the north, it had no competition (outside its own ranks) in the south and continued to flourish there. It evolved, too, of course, but the South American fauna was essentially archaic almost [illegible] lion years ago—which was long after the great majority of archaic mammals had died out in the north.

Then the Isthmus of Panama rose. The modernized mammals of North America, evolved now into such familiar forms as foxes, raccoons, bears, wild cats, peccaries, deer, horses, and tapirs, invaded South America over this land route. In the ensuing bitter struggle a few of the archaic forms, like the armadillos, managed to survive and even to get a foothold in North America, but almost all of them became extinct [illegible] northern origin. It was the Eocene struggle over again, long delayed by the accident that South America was an island in the Eocene and for long after.

[illegible]

The set is priced at $15.00 and is suitable for use in projectors taking the popular 2 x 2 inch slides.

MANGANESE Continued from page 217

them are shapeless, more or less compact, black masses, and, as mined, they are variable in composition.

Sometimes fine, sharp crystals of manganite and pyrolusite are found, but they are so rare as to be mineral specimens, not ores. The 1,200,000 tons of manganese ore used annually are these natural formless black oxides, and the artificial equivalents derived from the carbonate.

Manganese ores come to us from many lands. The principal exporters are the Gold Coast, India, Union of South Africa, Brazil, Russia, Cuba; and the American production of 1940 amounted to less than the imports from Cuba. None of these foreign sources has, as yet, been lost from the control of friendly nations, but difficulties of obtaining the ores from such distant places are increasing. There is no geological reason why manganese should not occur in this country in large quantities, except that it doesn't seem to, at least in rich deposits. The oxides of the workable deposits are secondary in origin, that is, they are derived from other manganese minerals through the process of weathering. Naturally it is a happy circumstance when iron ore has some manganese already in it. This often happens in bog iron ore—ore which was precipitated from waters in marshy places (as in the region of Lake Superior),—for manganese can be deposited by the same process of precipitation. Some of our best manganite crystals have been found in cavities in this type of ore.

We probably shall be able to work out our manganese needs well enough. Economies are being made in its use. Greater care in determining the least amounts necessary to get a workable steel have resulted in a reduction of the consumption; and a stock pile of some proportions has been built up. Also, recent government enterprise in the search for new processes of enrichment and recovery and the development of large scale operations will help us to become self-sufficient for the war period. But don't think that private enterprise could or should have done it under normal conditions as long as low cost, high grade manganese ores were available in other lands. One could only wish that those who are doing the most criticizing now had shown a little more foresight and enterprise in anticipation of the present emergency, instead of initiating the present well-planned campaign so late.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 240

1. If pursued by an adult grizzly, would you be safe up a tree?

   Yes. . . No

2. The Seminoles live in

   (a) Florida

   (b) North Dakota

   (c) British Columbia

3. Are the animals in North American Hall stuffed?

4. A scientific guess set up for examination and testing is a

   (a) Hypothesis

   (b) Theory

   (c) Axiom

5. Moose, caribou, and musk-ox are all

   (a) Members of the deer family

   (b) Herbivorous

   (c) Restricted to Alaska

6. Where is the only point in the United States at which four states come together?

7. What is the world's largest carnivore?

8. If they could be caught, mountain sheep would help greatly to overcome the present shortage of wool.

   True. . . . . False . . . . .

9. The female moose has antlers.

   True. . . . . False. . . . . . .

10. What plant menacing U. S. navigation is named after the object which the ancients threw in the path of military elephants to halt their attack?

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North American Camera Safari—indoors

By CHARLES H. COLES

T[illegible] permit to use a camera in the hall; and if the pictures are for personal use and [illegible] the Director. Whether one aspires to capture these animals on film or is simply [illegible] lems, a few words about the indoor camera [illegible] life-like exhibits, new heights have been reached in the use of color and lighting, so that the photographer is on his mettle to do justice to their artistry.

The point of view

B[illegible] the [illegible] by the amount to be included in the photograph. When a comprehensive view showing the entire group is wanted, the camera is placed at the proper distance from the [illegible] take in the edges [illegible] stopping perhaps just short of the frame of the case, as some persons feel that this impairs the natural effect. However, because the background of the group is painted on a curved surface, the height of the camera cannot be left haphazard. The perspective of these scenes will be correct only from one point of view: that from which the background was geometrically projected when the artists laid it out in charcoal. This point corresponds to the eye level of a spectator standing about three feet from the exhibit and directly in front of it. From this point of view a level horizon, like the skyline of Grand Canyon in the Mountain Lion Group, appears as a straight line. Photographed from above or below this level, the skyline would appear as a curve, producing an effect never observed in Nature.

To understand the finer points, it must be realized that the foreground of the group, containing the animals, is rendered in a solid, three dimensional form, whereas the background is painted in two dimensions. This means that at some place in each group solid objects must blend in with flat ones. The skill of the artists who paint these backgrounds is so high that the spectator, unless constantly reminded, finds himself fooled into the illusion that he is viewing real distances. This is in spite of the fact that we are equipped with two eyes capable of discerning depth in objects up to a distance of about 200 feet. The perfection of perspective in the groups will be strikingly impressed on the visitor if he will stand at the center of the glass panel and close one eye. With head held still, it is almost impossible for him to determine with certainty where the foreground leaves off and the painting begins.

Since the camera has one eye instead of two, it is possible to place it so that the perspective of the foreground matches that of the background, and then no dividing line will appear in the picture to destroy the illusion of reality.

These factors require that the cameraman place his lens about five feet from the floor, that is, on a level with the horizon. A wide-angle lens will enable the photographer to take in the whole group from a position that is closer, which is usually a better position with reference to the perspective of the group.

Illumination

The lighting effects of the groups have been worked out with painstaking care to give the effect of outdoor illumination. The addition of any other lights to the existing ones may destroy the effect so skillfully achieved.

Because the lights are placed in a chamber above the front of the group an obviously difficult achievement is the [illegible] of the figures nearest the glass. Even though they receive sufficient diffused illumination for a realistic effect when viewed by the human eye, the camera may record these animals darker than they would appear out-of-doors.

In taking the photographs reproduced in this issue of NATURAL HISTORY, the Museum photographers provided additional diffused light. In other halls this effect has been accomplished by throw[illegible] at the ceiling so that their illumination is reflected upon the figures in the group. But in North American Hall the dark blue of the ceiling precluded this method. Four lamps that could be raised to a height of fourteen feet were placed near the group and directed downward so as not to strike the background. The lamps in these were as small as [illegible] watts for the groups that were darker overall, and 200 watts for the brighter ones. Tiny spotlights were sometimes used to brighten especially dark fur, but great care was exercised to prevent the light from these from spilling over and producing unnatural shadows. By placing these lights as close as possible to the camera, the shadow cast by a figure was concealed by the figure itself.

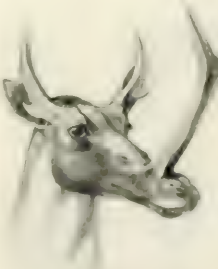
Color filters need rarely be used in taking black-and-white pictures of these groups, because of the exactness of their coloring and the ability of modern films to interpret most colors so accurately that correction is unnecessary.

For a realistic effect, the lens aperture should be left fairly wide. This puts the background slightly out of focus and adds depth to the picture. It also gives a quality we are used to seeing in a picture of a living animal taken in the field, where the lens is usually opened up to allow a rapid exposure.

Some of these preparations may seem complicated and beyond practical limits for a visitor to the hall, but excellent photographs of these exhibits are possible with no more equipment than a camera and a tripod. The most important thing beyond these irreducible necessities is a knowledge of just what your equipment will do and how to get the most out of it under unusual circumstances.

DO NOT MISS

THE ICE AGE, winnower of life on earth: its prelude and its far-reaching effects, will form the theme of the [illegible] articles in NATURAL HISTORY's panoramic series on animal history in North America. Paleontologist Edwin H. Colbert takes up the narrative where G. G. Simpson has left off in the current issue. He will depict the times when mastodons reigned supreme, and that later day when woolly mammoths stalked the icy fastnesses of what is now Nebraska.



No modern big-game hunter seems likely to turn up with a 45-foot crocodile in his bag. But Dr. Barnum Brown did! One of the world's outstanding fossil diggers lives to tell the tale in his article **THE LARGEST KNOWN CROCODILE**, soon to be published in these pages.

•

The camp life of a veteran archaeologist exploring some of the earliest Americans' hunting grounds in Montana will be recounted with rare charm by **NELS C. NELSON**.

YOUR NEW BOOKS

PLANT HUNTERS IN THE ANDES • APACHE WARFARE
A HISTORY OF SCIENCE • THE CURIES AND RADIUM
THE CREEKS IN OKLAHOMA • WEATHER PHENOMENA

APACHE DAYS AND AFTER

- - - - by General Thomas Cruse
Edited by Eugene Cunningham

Caxton, $3.50

ANOTHER Apache book deserving notice by those interested in these Indians is this autobiographical sketch by a veteran army officer who served through the wars with that tribe from 1879 to 1887. Some 240 pages are given to thrilling descriptions of fights with such famous leaders as Victorio, Chatto and Geronimo. There are full accounts of such engagements as Memtrillo, Victorio's destruction, Cibicu and Fort Apache, Dry Wash, and the surrender of Geronimo. Also there are interesting sketches of Generals Crook and Miles.

The author is General Thomas Cruse who, when just out of West Point, began service in Arizona in 1879 and was retired in the course of the World War in 1918. Of the 328 pages of text, 234 are devoted to the Apache campaigns. Years later Cruse was to discover that most of the engagements in which he participated and in which many enlisted men lost their lives were not even listed in the government records in Washington. Cruse seems to have been a man of rectitude, every now and then crying out against political manipulation and graft in Army affairs about which he could do nothing. Since Cruse writes as an eyewitness, those interested in the Apache wars will find some new information on controversial questions. For example, Cruse gives details to corroborate the disputed claim that Geronimo was not captured but that he surrendered. He states that an American officer went alone into Geronimo's camp and persuaded the treacherous chief to surrender.

CLARK WISSLER.

A SHORT HISTORY OF SCIENCE TO THE NINETEENTH CENTURY

- - - - - - - - - by Charles Singer

Oxford, $3.75

IT is no longer necessary to argue that the history of knowledge is as important and is as essential a part of a cultured person's comprehension of his world as is the history of nations or of arts. For the reader who wants one book on the history of knowledge, whether for pleasurable reading, intellectual stimulation, or factual reference, this is the best book that we have encountered.

Science, according to the definition that prefaces Singer's work, is an active process of acquiring or making knowledge. It is thus distinguished from technology, the application of such knowledge to a material end, which is almost excluded from this history. Science is, however, more than the acquisition of facts. It is also the organization and, at least, the attempted understanding of facts. This broader, more interesting, and more philosophical aspect of science is the essential theme of the book.

This theme is followed mainly in terms of individual scientists: what each learned that was new, and how this affected his thought and that of his successors. The problem of giving unified, comprehensible treatment of a subject so complex and confusing is solved with exceptional skill. Through all details and personalities a general, impersonal movement is always clear, from the rise of mental coherence among the Greeks through the great failure of later antiquity and the Middle Ages, to the resurgence of learning and its triumph in the nineteenth century. Much nineteenth century science is included, especially biology, and the history gives more than it promises by bringing the reader to the threshold of contemporaneous science.

There is an adequate Index of Persons, but a few more pages might have been added to the 400 of this short history to include an Index of Subjects and a Reading List.

G. G. SIMPSON.

WEATHER AND THE OCEAN OF AIR

- - - - by William H. Wenstrom

Houghton Mifflin, $4.50

HERE is an authoritative and entirely readable book on the science of weather. It carries a graphic and detailed account of the "ocean of air" which surrounds and overlies us, and of the wind currents which activate it. Clouds, winds, rain, snow, cold fronts,—all of the principal phenomena, and expressions of the phenomena, of the weather are clearly discussed, and in considerable detail. The treatment is based upon the essentially new methods developed by the introduction of the "air-mass-and-front analysis" theories, and as such is entirely up-to-date and modern.

The author, William H. Wenstrom, is a major, retired, of the United States Army Aerological Service. For a number of years he was in charge of the Army Weather Stations throughout Pennsylvania, Maryland, and Virginia and later was, for three years, the meteorological officer at Bolling Field, D. C. His authority is, therefore, unquestioned, and the impressive list of acknowledgments to specialists who have read and criticized the various chapters, leaves no room for doubt as to the authenticity of the material presented.

Particularly valuable are the data on home weather installations, observations, and forecasting; on farmer's weather, mariner's weather, and aviator's weather. In these days of war, when weather reports and forecasts are to be classed as information of military importance, an ability to foretell at least extremes of weather becomes of increasing value to people in many fields.

Interesting and very well-written, this book has all of the information to be expected from a textbook on the subject, without lapsing into the less interesting "textbook style" of writing. It is enthusiastically recommended.

H. E. VOKES.

THE ROAD TO DISAPPEARANCE

- - - - - - - - - -by Angie Debo

University of Oklahoma Press, $3.50

ANGIE DEBO was reared in a pioneer community at Marshall, Oklahoma where she has known from childhood the folkways of the Indians. She was educated at the University of Oklahoma where she received her A.B. degree and her Ph.D. She also earned a graduate degree at the University of Chicago. Miss Debo is the author of *The Rise and Fall of the Choctaw Republic,* which won the John H. Dunning prize of the American Historical Society for the best book submitted in the field of United States history in 1934.

The Chickasaws, Choctaws, Cherokees, Creeks, and Seminoles are known as "The Five Civilized Tribes." The Creeks, like the rest of these southeastern tribes, were forcibly removed by the United States Government from their ancestral homes and made to travel the "trail of tears" [illegible] They found that they had no guile to match [illegible]

[illegible]

PLANT HUNTERS IN THE ANDES

by T. Harper Goodspeed

Farrar & Rinehart, $[illegible]

THE author of this most readable book is Professor of Botany and Director of the Botanical Garden of the University of California. The story is told of two botanical expeditions sent out by the University at Berkeley, one in 1935-36 and the other in 1938-39. The personnel con[illegible] southern Chile, with a side trip to Juan Fernandez (Robinson Crusoe's Isle) in the South Pacific. Their plant hunting was not limited to the snowy highlands, but included the barren coastal deserts ("drier than the Sahara") and the tropical and [illegible] as well. The book is illustrated with 125 beautiful, well-[illegible]. There is, however, an apparent slip in the caption of Mount Osorno, the "Fujiyama of South America." In the wealth of illustrations, this reviewer missed one of the highly-prized aman[illegible]—a member of the amaryllis family—, that he saw in 1937 blooming at the foot of the Andes near Lima.

One of the main objects of the expedition was to search for wild species of tobacco (*Nicotiana*), and these they found in surprising numbers from small species to the tree tobacco, *Nicotiana* [illegible], which they found in Peru growing to a height of 40 feet. Doctor Goodspeed is probably the foremost authority on this group of plants. He has made tobacco plants a lifetime study, and he has in the Botanical Garden at the University of California the world's largest collection of living plants of *Nicotiana*.

Many other kinds of plants, however, were collected, and interesting facts about them are woven into the story. The book is nontechnical and human. It is an ex[illegible] book containing the things that [illegible] wants to know. Doctor Goodspeed is a gifted narrator, and he has given us a fascinating book.

CLYDE FISHER

RADIUM TREASURE AND THE CURIES

by Irmengarde Eberle

Crowell, $2.00

THIS small, popular book on Madame Curie and her momentous discoveries is intended for young people, and the author has made a most readable story of it. Commencing with Marie Curie's childhood, she traces the development of her interest in science and her determination, despite great handicaps, to achieve success in that field. Pierre Curie's background and progress are similarly followed to their meeting, marriage, and joint experiments and discoveries. For the author makes it clear that Pierre Curie's part in the discovery of radium was no small one, though his fame is usually overshadowed by that of his wife.

Following the biography of the Curies, some mention is made of the occurrences of radium, its recovery from the ore, and the uses to which it is put. The book is interestingly written, and should prove popular with the audience for which it is intended, even though the details are often rapidly skipped over—perhaps in a desire for brevity.

F. H. POUGH

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NATURAL HISTORY Magazine

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Central Park West at 79th Street, New York, N. Y.

Answers to Questions on page 237

1. Yes. Young grizzlies climb, but adults do not.
2. (a) The Seminoles are an Indian tribe living in Florida. See page 226.
3. No. The animals in North American Hall are mounted on a hollow manikin and are so light that they can easily be lifted.
4. (b) A scientific guess set up for examination and testing is a *hypothesis*. A *theory* is a supposition supported by principles; and an *axiom* is an established principle. See page 210.
5. (b) Moose, caribou, and musk ox are all herbivorous. See pages 196, 204, 199.
6. The only place where four states come together is at the four corners formed by Utah, Colorado, Arizona, and New Mexico. See page 215.
7. The world's largest carnivore is the Alaska brown bear. See page 195.
8. False. Although the mountain sheep is a true sheep, its coat is not woolly and is too coarse. See page 19[illegible].
9. False. The female moose has no antlers and is only about three-quarters as large as the male. See page 196.
10. Answer in next month's NATURAL HISTORY.

May **NATURAL HISTORY** 1942

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L E T T E R S

SIRS:

. . . May I add that I have enjoyed very much being a Member of the Museum. . . . I am a very busy Sector Warden, but when the NATURAL HISTORY Magazine arrives each month, I . . . take time out to relax and read it from cover to cover. It is both educational and immensely interesting. I love animals and birds and enjoy stories about them.

MRS. EMMY NEWMARK.

Brooklyn, N. Y.

* * *

SIRS:

. . . NATURAL HISTORY is the most interesting and informative magazine I know of. I look forward to its arrival every month and have a hard time to put it aside when I should be doing something else. . . .

Madawaska, Me.

ROY W. NICKERSON.

SIRS:

I just received the Membership Certificate, and am greatly pleased with NATURAL HISTORY Magazine; it is wonderful.

CHARLES DUKE.

Chicago, Ill.

* * *

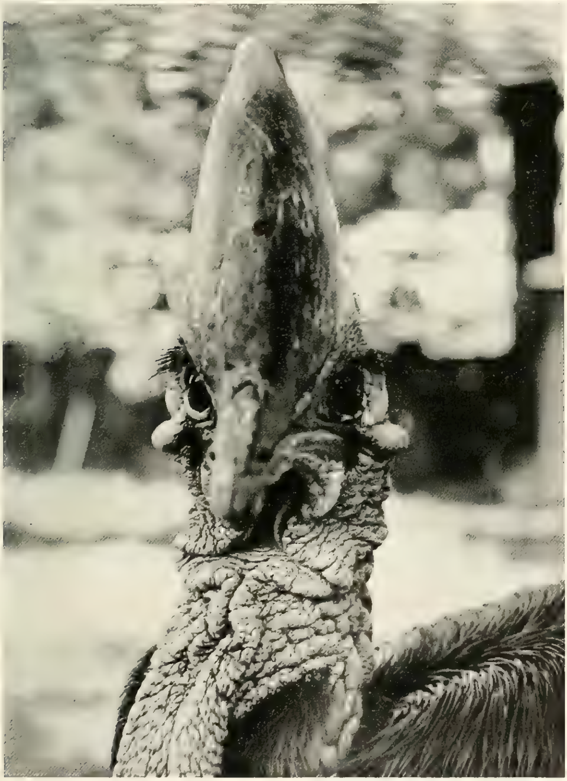
SIRS:

As one of many who always looks forward to receiving your intellectual magazine, may I comment on the very interesting article by Miss Cypher, entitled "The Story of Our Map."

I shall always cherish your valuable magazine, as it contains learning of the highest standard.

A. ALLAN CAMPBELL.

Port Washington, N. Y.



Penguin photo, taken at the N. Y. Zoological Gardens

An unusual portrait of an unusual bird: one of several kinds of cassowaries—fleet-footed birds native to New Guinea, Australia and the Aru Islands

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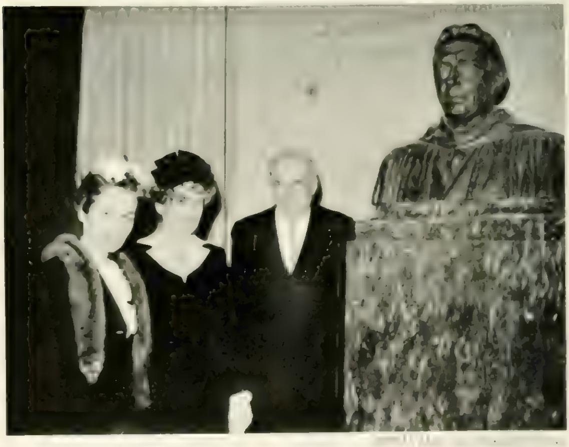
HENRY FAIRFIELD OSBORN

For him the dry bones came to life,
And giant forms of aeons past
Resumed the pageant of the ages.
—William K. Gregory

Henry Fairfield Osborn was president of the American Museum of Natural History for 25 eventful years from 1908 to 1933, and his death in 1935 marked the close of one of the greatest careers in the long history of the institution.

Last month on the occasion of the fourteenth annual Members' Visiting Day, solemn tribute was paid to his memory. As a fitting prelude to the opening of the new Hall of North American Mammals, Dr. William K. Gregory, one of Professor Osborn's most distinguished students, and Dr. James Rowland Angell, former president of Yale University, addressed the huge gathering prior to the unveiling of a bronze of the late president sculptured by Joy Flinch Buba.

Speaking of Professor Osborn as a mammalian paleontologist, Doctor Gregory showed how his inspiration stemmed directly from those nineteenth century giants, Darwin and Huxley. He traced his career through the founding of the Museum's paleontology department up to his tremendous monographs of later years, notably that on the Proboscidea. Doctor Angell emphasized the "creative" element in Osborn's character which, he said, was confined to no one line of endeavor. As scientist, executive, explorer, and man of religion, Henry Fairfield Osborn was equally inspired. The future can only enlarge his fame.



UNVEILING. Mr. A. Perry Osborn, First Vice-president of the American Museum of Natural History, stands beside the bust of his father, Henry Fairfield Osborn. Beside him are his sister, Mrs. Jay Coogan, and Joy Flinch Buba, who sculptured the bust

Sirs:

I would like to say at this opportunity that this magazine is the most interesting and valuable I have ever subscribed to—I am a sculptor of animals and birds—and is particularly welcome in this somewhat isolated spot.

Bernice Barondes

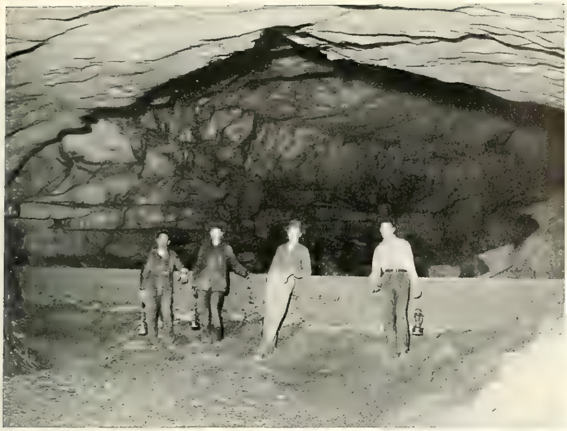
Trinidad, B. W. I.

Sirs:

I would like to express my gratitude and praise for the wonderful photographs you have in your magazine. They are beautiful to look at and yet they add to my knowledge of photography.

D. J. Lasley

Bronxville, N. Y.



Photo, Courtesy of the U. S. Department of Interior

A natural dam in Mammoth Cave, not yet open to the public. An irregularity in the floor possibly started the dam, when water rippling over it precipitated calcium carbonate. The dam is now dry. Note the travertine "corn flakes" in the foreground

SIRS:

The "Letters" section of NATURAL HISTORY for last October included a letter from Duane Featherstonhaugh of Schenectady, New York, and a picture of a limestone dam in Balls Cave near Schenectady. This feature appears to be the same type as two travertine dams in the New Discovery section of Mammoth Cave National Park in Kentucky, the larger of which is shown in the accompanying photograph. It is 42 feet three inches long and a little more than four feet high. The smaller dam, about twelve feet farther downstream, is only about two and one-half feet high.

Although the cave is not yet open to the public, the geological report on the formation of these dams might be of interest to your readers. In 1939, Mr. Donald C. Hazlett of the National Park Service investigated the New Discovery section of Mammoth Cave and described the larger dam as follows:

"Perhaps the most unusual feature in the New Discovery is the large travertine dam already erroneously called the 'Onyx Wall.' This dam impounded water for a small lake approximately 40 feet wide and 70 feet long, the width, length, and depth increasing as the dam was built higher and higher.

"Deposition of calcium carbonate at the dam site probably began because of an irregularity in the floor which caused a rippling of the water which in turn caused a liberation of carbon dioxide. With this loss of carbon dioxide from the water, calcium carbonate was precipitated. In this manner the deposit of travertine was gradually built up and formed the dam. Another factor is that there was probably in early times an outside opening and the air currents resulting facilitated such deposition. The currents of atmosphere likely had a carbon dioxide content below that required to maintain equilibrium with the carbon dioxide of the water and the escape of gas from the water was favored, thus causing precipitation. Also temperature changes caused by the air currents would tend to bring about deposition.

"Another unusual type of travertine deposit which has developed in connection with these small lakes is the flake-like particles (which resemble corn flakes) that have collected from three to ten inches thick in the lake basins. It seems that these deposits of calcium carbonate were formed on the surface of the water as an ice-like film which later broke up into flakes and settled to the bottom."

CARL P. RUSSELL,
Supervisor of Interpretation.
National Park Service,
Washington, D. C.

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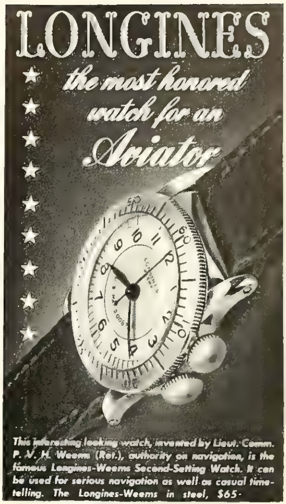

This interesting looking watch, invented by Lieut. Comm. P. V. H. Weems (Ret.), authority on navigation, is the famous Longines-Weems Second-Setting Watch. It can be used for serious navigation as well as casual time-telling. The Longines-Weems in steel, $65-

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The unsurpassed technical and production facilities of the Longines factory are proved by the great accuracy of Longines aviation watches. These same fine facilities make all Longines Watches better watches. They keep good time for a longer time. Longines honors include 10 world's fair grand prizes and 28 gold medals. Longines-Wittnauer jewelers show the new Longines Watches; also Wittnauer Watches, a companion line of moderate price, from $29.75—product of Longines-Wittnauer Watch Company.

Longines Watches have won 10 world's fair grand prizes, 28 gold medals

Illustrated: Longines Trinidad (top left) $93.50; World's Fair LA (top right) $67.50; World's Fair strap (center) $67.50; Hall of Fame men's bracelet $82.50

[illegible]

[illegible] that the long accepted and generally held [illegible] molecule by molecule, cell by cell replacement. There is little or no factual basis for this theory, however, and Dr. William C. [illegible] and Dr. Chester A. Arnold of the University of Michigan have recently presented evidence* indicating that the replacement theory cannot adequately explain the phenomenon of petrification.

[illegible] Either there is a direct chemical reaction between the inorganic solutions present and the cellulose and lignin making up the wood, or the original organic material was dissolved away and the mineral immediately took its place. Doctor Arnold effec[illegible] out the lack of evidence to support a chemical combination of most inorganic sub[illegible] and the very insoluble character of cellulose and lignin. Corroborative evidence has been obtained in experiments conducted in Petrified Forest National Monument where we have dissolved the silica of petrified wood in hydrofluoric acid and have found that some specimens have a residue of woody matter.

We now believe that we must explain the petrification process as an infiltration of mineral solutions with subsequent deposition of minerals, rather than as a direct replacement. Some decomposition due to hydrolysis or fungous action was undoubtedly present prior to the mineral deposition. The degree of this decomposition must have a direct relationship to the amount of woody matter now retained in the petrified wood.

This explanation eliminates the questionable chemistry of the replacement theory. Certainly we must admit that the assumption of direct replacement is untenable and that the term "deposition" better describes the process of petrification.

BENNETT T. GALE,
Park Naturalist

Petrified Forest National Monument,
Holbrook, Ariz.

• • •

SIRS:

A captive garter snake gave birth to a litter of sixteen snakes while I was watching them. One after another they were expelled as the female wandered around in the four by four terrarium. Less than an hour after the last snake was born, I noticed one of the babies swallowing another. I let the process go on until the swallower could swallow no more and then preserved both of them.

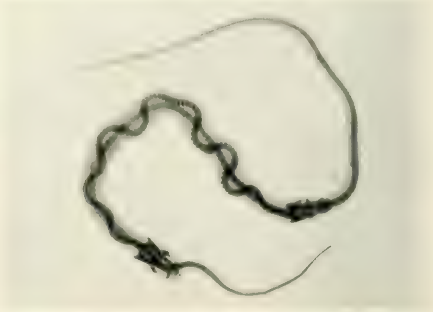
[illegible] ine method of clearing and staining with Alizarine Red S, I cleared the snakes, and they were then photographed by Arthur [illegible]

[illegible] parent and every structure can be clearly seen. The swallower is [illegible] its back in the photograph.

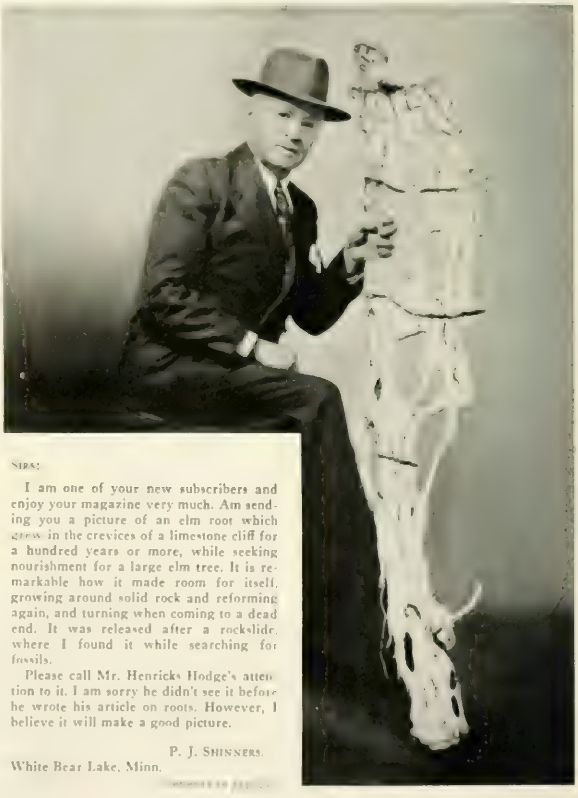
Perhaps this will be of interest to the readers of Natural History Magazine.

HOWARD E. EVANS

Cornell University, '44,
Ithaca, N. Y.



An actual photograph of a snake within a snake, the tissues having been rendered transparent



SIRS:

I am one of your new subscribers and enjoy your magazine very much. Am sending you a picture of an elm root which grew in the crevices of a limestone cliff for a hundred years or more, while seeking nourishment for a large elm tree. It is remarkable how it made room for itself, growing around solid rock and reforming again, and turning when coming to a dead end. It was released after a rockslide, where I found it while searching for fossils.

Please call Mr. Henricks Hodge's attention to it. I am sorry he didn't see it before he wrote his article on roots. However, I believe it will make a good picture.

P. J. SHINNERS.

White Bear Lake, Minn.

[illegible]

---

*[illegible]

Railway Excursion and Buffalo Hunt

An excursion train will leave Leavenworth at 8 A. M. and Lawrence at 10 A. M. on Tuesday, October 27, 1868, and return on Friday.

This train will stop at the principal stations both going and returning. Ample time will be had for a grand BUFFALO HUNT ON THE PLAINS.

Buffaloes are so numerous along the road that they are shot from the cars nearly every day. On our last excursion twenty buffaloes were killed in a hunt of six hours.

All passengers can have refreshments on the cars at reasonable prices.

Tickets for round trip from Leavenworth, $10.

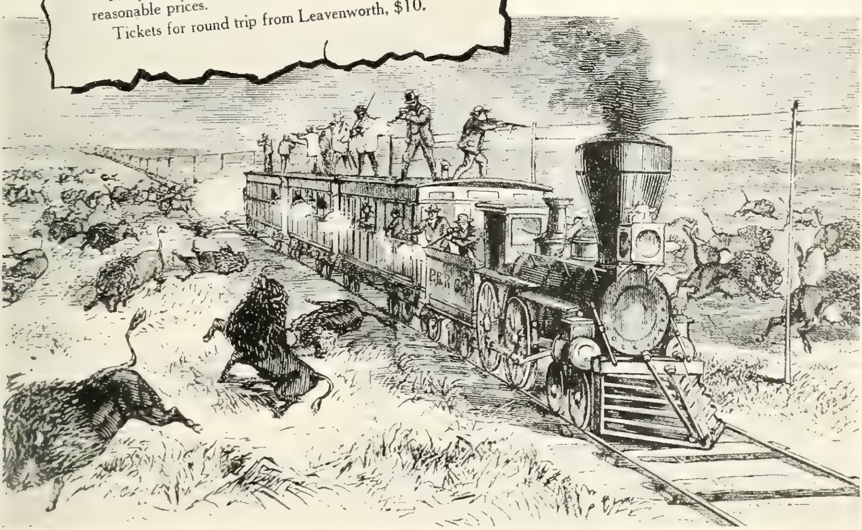
By BRUCE BROWN

The advertisement at left was printed in a Cincinnati newspaper 73 years ago. Then the bison or buffalo was the King of the Plains. Now it is almost extinct. Where probably 60 million of these animals roamed the ranges of America at that time, there are only a few more than 5000 now living on federal, state, municipal, and private domains.

The country is less picturesque without them. But the buffalo of today has nothing to fear, and that's his side of the story. In the interest of national resources in wildlife, Americans should remember stories like this, lest our abundant heritage of yesterday become a hopeless dearth tomorrow.

(Below) Slaughter for a pastime (From a woodcut of 1883)

The Bettmann Archive



ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Spring, 1942.

SUNDAYS over the Mutual Broadcasting System from 9:30 to 10:00 A. M.

This Wonderful World. Quiz program, with young people answering questions on nature subjects.

WEDNESDAY over the Columbia Broadcasting System Network from 9:15 to 9:45 A. M. (Central Time: 2:30 to 2:55 P. M.; Mountain Time: 9:30 to 10:00 A. M.; Pacific Time: 1:30 to 2:00 P. M.)

Lands of New World Neighbors. (New Horizons: C.B.S. School of the Air.) The dramatic story of men and events that are the fabric and fiber of New World exploration and expansion.

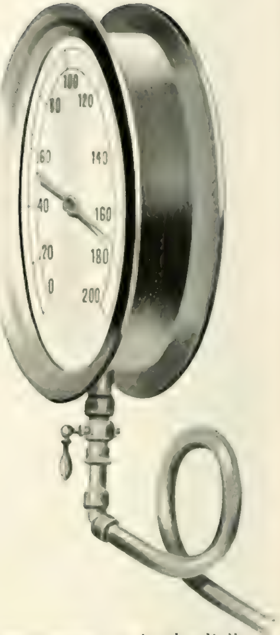
WEDNESDAYS, May 6, and May 20, over WNYC from 3:30 to 3:45 P. M.

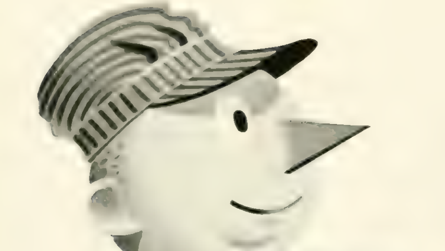
Know Your Museum.

FRIDAYS over the Columbia Broadcasting System Network from 4:15 to 4:30 P. M.

Americans Map the Skies. The story of the growth and development of astronomy in America.

"Carrying lots of pressure these days..."





"There is more steam up in the Bell System than I ever remember. The wires hum with war and wartime production. There's more telephoning than ever before.

"The pressure of war and war's work is on—especially on our toll lines. If you are going to use Long Distance you can help by—

Knowing the number you want to call.

Calling in the less busy hours — before 10 A. M. and after 8 P. M., for example.

"Let's give vital war calls the right of way and make equipment go as far as possible, saving copper and other materials for the war."

BELL TELEPHONE SYSTEM

"The Telephone Hour"—*presenting great artists every Monday evening*—*N.B.C. Red Network*

NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President
WAYNE MOODY FAUNCE, Acting Director

VOLUME XLIX—No. 5 ★ ★ ★ ★ ★ ★ **MAY, 1942**

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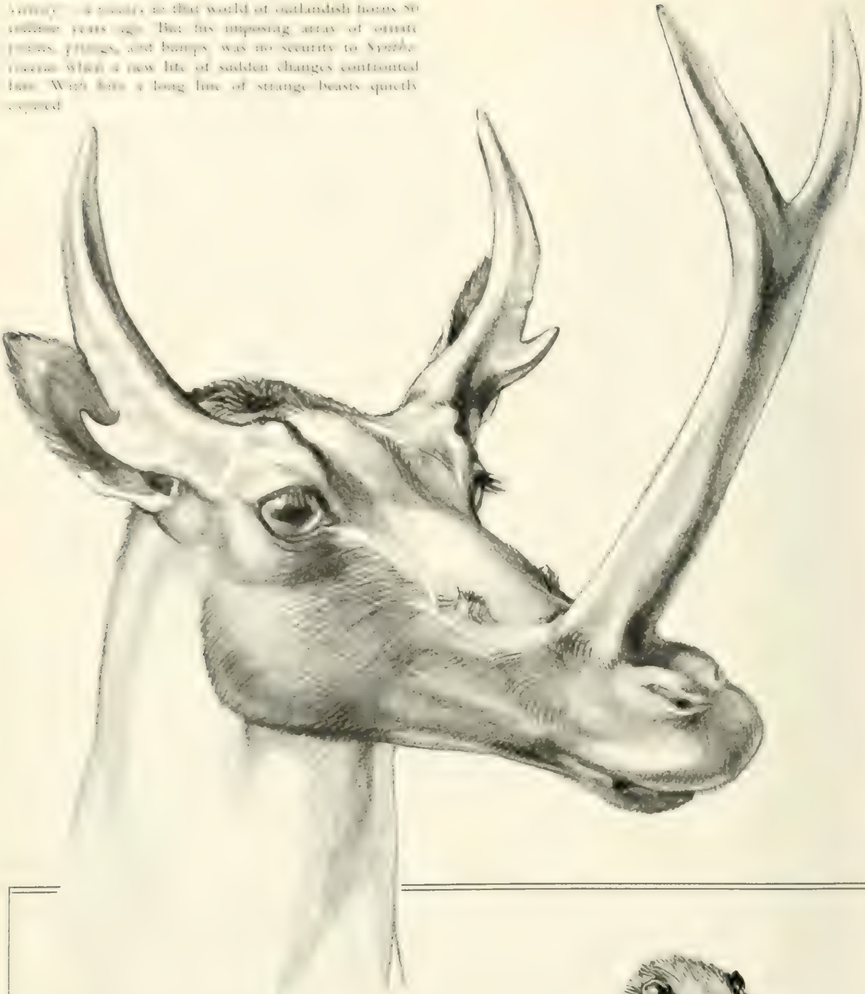
THIS FANTASTIC CREATURE unwittingly sports a "V for victory" [illegible] in that world of outlandish horns so [illegible] years ago. But his imposing array of ornate points, prongs, and bumps was no security to Synthetoceras when a new life of sudden changes confronted him. With him a long line of strange beasts quietly expired



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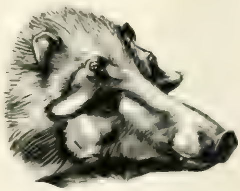


(Right) STRANGE, LONG-FACED PECCARIES once lived in Nebraska

(Opposite) A "conservative" of the Age of Horns: *Sphenophalos* may well have been an ancestor of the persistent line of North American antelopes, of which the pronghorn is sole survivor

CIRCUS
without spectators

No human eye witnessed the parade of strange creatures in that age of superspecializations, but science reconstructs the surprising pattern from which our modern animals emerged

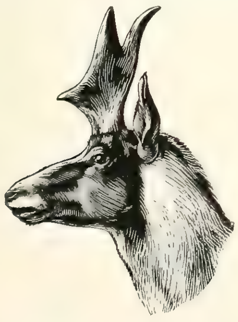
By EDWIN H. COLBERT

Assistant Curator of Vertebrate Paleontology, The American Museum of Natural History

FOR millions of years after the disappearance of the last dinosaurs and on through the long period during which archaic mammals were dominant on earth, the geologic history of North America, of the world for that matter, progressed in a steady and, one might say, comparatively placid fashion. Lands that were low and tropical when the mammals first began to flower were gradually uplifted to become high, grassy plains. Imperceptibly the mountain chains of the West came into being. The entire continent slowly pushed up and up until the landscape took on those features of hill and vale, mountain and plain closely resembling its present-day lineaments.

And with the implacable evolution of the continent toward its more modern form there were concurrent developments among the mammals, which had inherited this strange new world from their reptilian ancestors.

The mammals, it will be remembered, are the warm-blooded animals which generally give birth to living young instead of laying eggs and are able to nurse their offspring through earliest infancy. The importance of this chapter in evolution is evident when we realize that it concerns the ancestry of our most familiar four-footed animals of forest and plain.



At first changes were slow, as Doctor Simpson has pointed out in the two preceding chapters of this story. There was a long period of "experimentation" following the Great Invasion of more modern mammals into the New World, a period when Nature seemed to be trying out various models of animals, apparently in an effort to determine the forms most suitable for a continued existence in a fiercely competitive Scheme of Life. Many of the early experimental models were tried and many were found wanting, but out of the great melange of strange, primitive beasts which evolved between 40 and 60 million years ago during the earlier phases of the Tertiary period, some forms, more adequately fitted for continuation than their contemporaries, survived to give rise to the great mammalian faunas of later Tertiary times.

The later phases of the Tertiary period, notably the Miocene and Pliocene epochs, were pre-eminently the Age of Mammals. This was the time for the culmination of many lines of mammalian descent; it was the time when the earth was inhabited by hordes of beasts of different kinds and of high specializations. These numerous four-footed mammals, many of them of peculiar form and aspect, truly reigned supreme, for at that time there was not yet the unquiet and disturbing biped known as Man to contest their rule of the earth. They lived their separate but integrated lives unseen by the avid human eye. They marched and countermarched in imposing array across the face of the continent in processions of magnitude. They were the menagerie of an ancient circus without spectators.

These animals of the late Tertiary were for the most part wonderfully adapted to the environments in which they lived. They were suited to almost every conceivable "ecologic niche" of the late Tertiary world—that is, they were specialized to varied modes of life on the plain and in the forest, to grass-eating and to meat-eating, to burrowing and to climbing, to protection by virtue of their great size, and to escape by running. All of the exigencies of life on the land were met by the evolutionary development in these animals. Like the animals of our present-day world, these late Tertiary mammals had become modified to take advantage, each in his own fashion, of the varying conditions around them.

They were like the mammals of our present-day world, yet unlike them. True enough, many of them [illegible] yet they were still sufficiently lower than their modern grandchildren to appear noticeably primitive to the modern eye. On the other hand, many of the animals of late Tertiary times were end products in themselves and had developed along lines that seem [illegible] signs in mammalian architecture.

What was the world like in those distant days? Were not the inhabitants of an earlier land than ours strange and wonderful to behold? Let us project ourselves back through the mind's eye to a scene in the western part of North America of that ancient day— [illegible] the beginning of the Pliocene epoch.

In those days the high plains of the West were not greatly different in appearance and development from what they are today. There were extensive rolling grasslands cut into mosaics by shallow streams, along which grew fringes of trees and small bushes. The climate was warm and fairly arid, perhaps without the extremes of temperatures that are so characteristic of that region today. Very likely the winters were considerably less frigid than our modern winters, so that there was in North America an environmental condition not unlike that of the modern African veldt.

Most apparent in the scene of that day, even as now, would have been herds of hoofed mammals that lived on the open prairie, and of all the later Tertiary mammals perhaps none were more markedly different from their modern counterparts than these grass-eaters.

Rhinoceroses in Nebraska may seem to be something of an anachorism to us, but there they were. Not the rhinoceroses of today, but heavy squat short-legged animals, ungraceful and almost hornless. It may be that these were water-loving rhinos, spending much of their time along the shallow watercourses of those ancient plains.

Drifting across the grasslands were herds of horses, —unmistakable horses, but horses in miniature. For these later Tertiary horses, though various, were all of pony size. Some of them were of the three-toed type, the persistent and conservative followers of their ancestors of ages long past; others were the more progressive single-toed horses, foreshadowing in form and structure their descendants of modern times.

Peccaries lived in ancient Nebraska, not the peccaries that we know from our modern tropical and subtropical America, but large, long-faced peccaries, many of them with large projections or bumps on [illegible] have looked something like the wart hogs of present-day Africa.

If the rhinoceroses of later Tertiary times may be styled as "sawed-off," the North American camels of that age were just the opposite, the slim-jims of their day. These were greatly elongated animals, with stilt-like legs and giraffe-like necks, towering into the rarified upper strata of the available food supply. And though strange of form, these perpendicular camels should not be regarded as strange in their occurrence, for the entire heritage of these animals was peculiarly North American. Here they arose and developed, and it was only at a later date, in the great Ice Age, that the camels emigrated from their North American homeland to newer lands, finally to become extinct in the land of their origin.

Here also were the last of the oreodonts, a group of hoofed mammals that lived and developed through a major portion of the Tertiary period. They were unlike anything now living, rather short-legged animals, some of them as large as sheep. The head was remotely sheep-like, rather deep and without any horns or bony outgrowths; and they had four well-developed toes on each foot, and a long tail.

But strangest of all the varied grass-eaters of those distant plains were the numerous horned and antlered forms. In some of these animals evolution seemed to have "gone on a bender," for nothing like these animals should reasonably be expected outside the world of dreams or of delirium tremens. Here were deer-like animals with "horns" or "antlers" of a bewildering variety. Many had the usual pair of such structures at the back of the head above the eyes, in some cases curved in, in other cases curved out, in some cases directed backward, in other cases pointing forward; but others had prongs and points jutting out of all sorts of strange and unexpected places on their skulls, which gave them nightmarish aspects, to say the least. Our knowledge of these peculiar horned animals has been greatly augmented in recent years by the collections of the Frick expeditions of the American Museum—indeed, a whole new world of peculiar mammalian types has been opened up as a result of this work.*

This was an age of *three-horned* animals, of beasts which sported a single median horn in addition to the usual pair above the eyes. One of these triple-horned grazers, *Synthetoceras* by name, had two very adequate and ornate structures over the eye sockets and then, as if this weren't enough, he had an unbelievably long prong, forked at its tip, projecting up from the front of the nose. In addition he had a couple of small knobs on the sides of the skull. And then to supplement this array of points, prongs, and bumps, a pair of well-developed canine teeth or tusks peeped out from beneath his fleshy upper lip. Needless to say he was one of those end products of evolution, and with him a long line of strange beasts quietly expired. Which is our loss, for he must have been something to look at. Bounding along with his head up before the prairie wind on a stormy day, he must have looked like some sort of peculiar three-masted schooner with all of the canvas hauled down.

---

*[illegible] North America," [illegible] LXIX

Another one of these unorthodox grazers had a third horn growing right out of the back of his skull, like the stern flagpole of a small ship. Our knowledge of this animal, known as *Cranioceras,* came about as follows: a score or more years ago, the late Dr. W. D. Matthew, then Curator of Fossil Vertebrates at the American Museum of Natural History, found in northwestern Nebraska the single median horn of this animal and recognized it for what it was. He named the animal on the basis of this fragment, and predicted what might be expected when the entire skull should be found. Many years later, not one but several skulls of *Cranioceras* were found by the Frick parties, and they showed a median horn, as Matthew had prophesied, but they also showed what Doctor Matthew had no way of guessing, namely the additional pair of horns above the eyes. Even so, this confirmation of Doctor Matthew's shrewd prediction indicates the depth of knowledge and perception possessed by that great paleontologist.

Of course not all of the horned animals were quite so outlandish as these three-horned fellows. Indeed, some of the horned grazers of that distant day were relatively conservative, and as might be expected these were for the most part the ancestors of persistent evolutionary lines. For instance, there was a large variety of antilocaprids, of which our modern pronghorned antelope is the sole survivor. Some of these early antilocaprids were rather deer-like, with branched "antlers" on their skulls, but others, although tending to favor the ornate in their horn development, were even then prophetic of the pronghorn. There were other horned grazers, too numerous to mention, but perhaps this gives some idea of what might be expected of these animals in North America during the Pliocene age, several million years ago.

It was an age of horns—even the rodents had them. In the late Tertiary deposits of the high plains there was a whole series of horned gophers characterized by transversely paired horns on the nose.

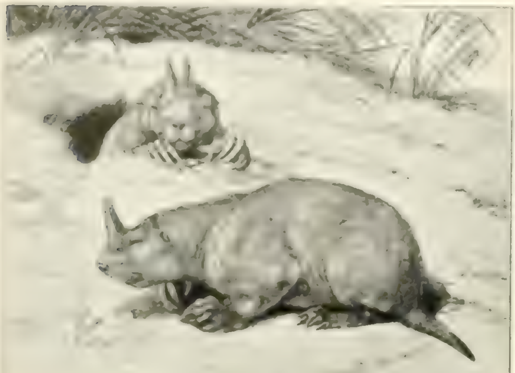
Grazing and browsing with the hoofed mammals on the open plains were the tusked and trunked mastodonts, the Tertiary forerunners (but not the ancestors) of our modern elephants. There were several kinds of these, most of them characterized by four tusks, two in the upper jaws—as in the modern elephants— and in addition two in the lower jaw, which was greatly elongated. All of these long-jawed mastodonts were peculiar, but perhaps the prize of the lot was the animal known as *Amebelodon,* the so-called "shovel-tusker," in which the lower tusks were not rounded in the orthodox fashion, but flattened to form broad scoops, enabling these animals to poke around in the mud and among shallow-water plants of the prairie streams for their food. In addition to the peculiarity of its tusks, the lower jaw of *Amebelodon* was unbelievably long, and one wonders how this animal negotiated hillocky ground without constantly ramming his lower tusks into the earth like a broken down wagon-tongue. At any rate, *Amebelodon* did exist, there are his bones to tell us so, and he was seemingly successful for a while. It is probable that the trunk of this animal was not round as is usual among the proboscideans or elephant-like animals, but flattened, a sort of elongated upper-lip,—which is really what it was.

No picture of animal life is complete without the beasts of prey which live upon the grass-eaters. And there were many such hunters in Nebraska of long ago. But they did not show the bizarre developments so apparent among the grazers. Here we come into the realm of ancient dogs, some of them ancestral to our modern wolves and foxes, others of gigantic size —obviously the culminations of lines long in the process of evolution. Here were the late Tertiary cats, of different sizes but not so very different in form from our modern felids, except for those of the sabertooth variety, with their great, scimitar-like canine teeth. Here were the weasels and their ilk, the badgers and the skunks, the raccoons and all of the various lesser carnivores that found their living off the small rodents and other small fry which scampered along miniature runways through the grass roots, or sought protection beneath the soil in subterranean burrows.

Such was the Parade of Life long ago—a parade of forms both familiar and strange to the eye of modern man. In it were the ancient dogs and cats, the various gnawing rodents, the horses and other animals, marching toward a future of continued evolutionary development. But also there were in it the peculiar short-limbed rhinoceroses, the stilt-legged camels, the shovel-tusked mastodonts and the host of bizarre horned ruminants marching toward the oblivion of extinction.

Why should this be? Why should those delightfully strange beasts die out at a time when they seemingly were riding along so successfully on the crest of a wave of evolutionary development? Why did they disappear, to be succeeded in modern times [illegible] animals with their shovel jaws, their short legs and long legs, and their varieties of horns and prongs could not make the adjustments necessary to survive the gathering changes, so they gradually died out, to [illegible] ernized" types that succeeded them. It is the old, old [illegible] rocks. Only the fit survive, and when the environ [illegible] change with it or adapt themselves to the new conditions that are being established. The highly spe [illegible] may be for existence under the old conditions, must [illegible] the stringencies of new conditions.

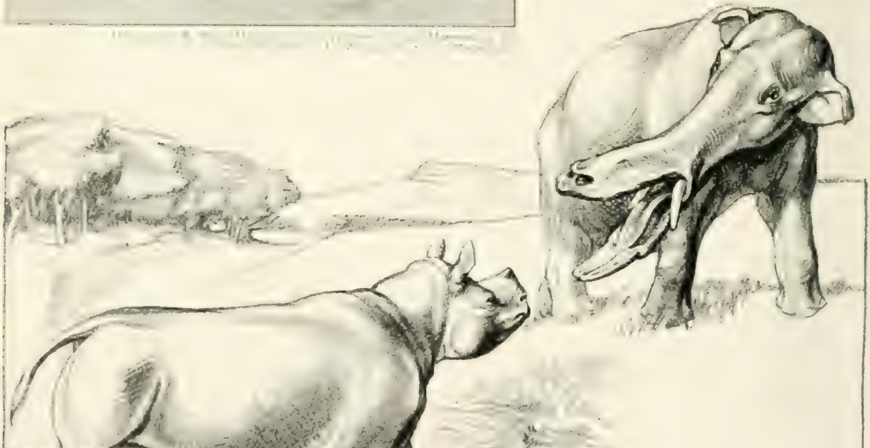
So it was that numerous denizens of America succumbed in the final stages of the Tertiary period. [illegible] horde that came in with cold winds from the north, with the ice and the snow.



[illegible]

EVEN THE RODENTS had horns. Transversely paired horns on the nose were characteristic of the late Tertiary gophers that scampered over the western high plains of North America

(Below) NATURE'S LONG PERIOD of "experimentation" included a squat, "sawed-off" rhino and a mastodont whose peculiar flattened tusks distinguished him as the "shovel-tusker"



An AMERICAN comes back

By BEN EAST

Once hunted to the threshold of extinction, the upland plover begins to lift his strange rolling call again in western pastures

ALL PHOTOS BY THE AUTHOR

It is more difficult to photograph a bird than to shoot it—and easier on the bird

His home in the old days was on the open prairies, in the rolling grassy fields, the dry meadows. That's why they called him the prairie plover, the prairie dove, the hillbird, the prairie snipe, the pasture plover,—and even "quailie," most affectionate of all his titles.

It is there, on the prairies, the hills and pastures, that the upland plover, a native American once condemned to extermination, is making his slow comeback.

In the beginning he was an abundant bird from the open fields of Cape Cod to the wide prairies of Saskatchewan. There was a time, birdmen relate, when this tall plover of the mellow voice was as plentiful in New England as the meadowlark, when he haunted the open fields of Minnesota in countless thousands, when the broad prairies of the West knew his kind in flocks the like of which no gunner of this generation has ever seen. In those days every grassy field, every reach of prairie in his far-flung range sheltered a nesting pair or two of upland plovers.

Then the market hunters turned their guns on this tall shore bird who shuns the shore, and the days of his primitive abundance came swiftly to an end.

No one will ever know, apparently, the details of how the market gunners slaughtered the upland plover for trade. No one will ever be able to fix exactly the toll they took.

The records are sketchy and incomplete, the available evidence fragmentary. The men who shot for market in those "good old days" kept few accounts. Of those who did the killing and might supply the story firsthand, few are left alive today. The plover harvest followed close on the heels of the pigeon

[illegible]

But [illegible]. And [illegible].

We know the [illegible]. We know [illegible] were shipped to the game markets of the big cities [illegible]. We know the [illegible] snipe brought high prices and was in good demand. The gunners met the spring flight on the prairies of the West, and they shot again when the birds began to move south in late summer. It was a "popular method" to drive a team and buckboard within gun range of the flocks when they were too wary to be approached on foot.

"About 1880, when the supply of passenger pigeons began to fail," Forbush sums up the story, "the marketmen, looking about for some other game for the table of the epicure in spring and summer, called for plover. Then the destruction of the upland plover began in earnest."

The guns took their toll, for market and sport alike. There was in that day no law to protect shore birds or other wildlife. We had plenty. It would last forever. If it didn't, let tomorrow look to itself. At the same time cultivation and drainage and burning reduced the prairies where the quailie nested. So its ranks thinned, and by the turn of the century there was good reason to believe its death warrant had been signed. There was little reason to hope that the upland plover would have the chance to come back.

What Dr. Thomas Roberts had to say of the situation in Minnesota applied to conditions over all of the plover's original range. "Here and there an occasional breeding pair may yet be found," he wrote, "but they are lonely occupants of the places where their ancestors dwelt in vast numbers."

By 1910 few birdmen would have ventured an optimistic prediction for the future of the quailie.

"We know of few places where it breeds now and its voice on migration is seldom heard," said Barrows, writing of the upland plover in Michigan in 1912.

In my youth, 30 years ago, the bird was entirely unknown in his old haunts in the clover fields and pastures of southern Michigan. As a boy I never saw an upland plover or heard the sweet trilling cry of one roll across the June meadows. Killdeers we saw aplenty on the wet lowlands. Larks were abundant in the hayfields, the bobolinks in the marshes. The bittern walked the ditchbanks, and we knew him as the thunderpump. The great blue heron waded the ponds and lake margins, tall and solemn and deliberate. Flickers and bluebirds nested in our orchard, and barn swallows tormented our farm cats, swooping out from their mud lairs beneath the dusty barn [illegible]. Birds we knew of many kinds, but not the [illegible]. As a farm lad I never heard even his name.

Later I came to know of him. I heard something of the bloody record of the market gunning. But even then, no more than 20 years ago, I never hoped to see this plover nesting in our meadows again.

Rumors of return

Then the word began to get around that he was coming back. A pair was seen here, another there. He was still persecuted in his wintering grounds on the broad pampas of South America, where he has unfortunately inherited the reputation of the lost Eskimo curlew as a table bird; and to this day he is hunted relentlessly for market through the months of the northern winter. But the bird was showing up once more in his old haunts in the midlands of the United States in May and June.

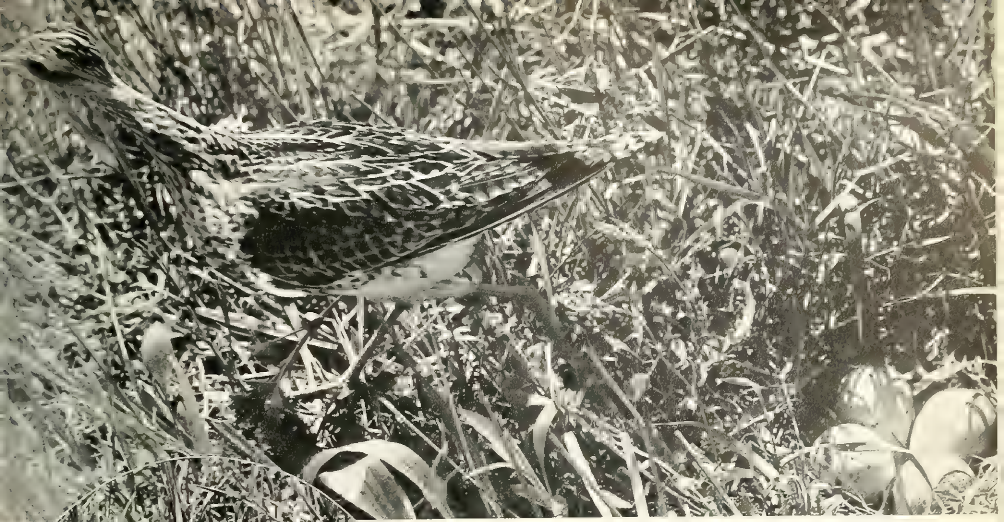
At last there came a red-letter day when a pair of upland plovers was reported nesting in a county in north central Michigan. It was the first nesting record for the state that had ever come to my attention.

A camera-hunting friend of mine, Walter Hastings of the Michigan Department of Conservation, visited that nest, put up his blind in the short grass a few yards away and made a film record of the hen plover on her eggs. No bird pictures thrilled me more than those. This was a bird I feared we might never see again, a bird which had stood on the very threshold across which heath hen and passenger pigeon and Eskimo curlew passed beyond recall.

A few more springs passed and word came to me of an upland plover nest within 20 miles of my home. I packed my cameras and searched out the farm with high hopes. But I came back without pictures.

The nest was there, and the two plovers circled around us and set the field ringing with their sweet trilling alarm cries. But while we stayed in the vicinity of the nest they refused to come near it. We set the camera on a tripod and ran a silken line back 50 yards to a hiding place beside the fence, but the birds were afraid of the strange black box on three legs, and we gave up finally, unwilling to risk chilling the eggs by keeping the hen plover from them longer.

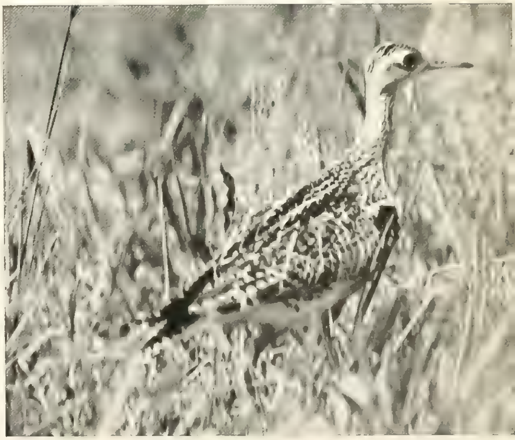
For four years after that I saw no more upland plovers, although scattered reports indicated a steady gain in nesting records in our part of the country. More and more frequently birdmen saw the quailie in the summer fields. More and more the farmers of southern Michigan became familiar again with the strange rolling call that is so like the trilling of a tree toad, although few of them could name the long-legged, dun-colored bird that made it.



"GONE the way of the heath hen, the passenger pigeon, and the Eskimo curlew," was the sad verdict of bird lovers a few decades ago. But these pictures, taken more than 50 years after the ruthless market slaughter of the eighties, reverse the decision. *(Above)* A mother plover leaves her nest just as the camera clicks, revealing her share in the future. Unlike countless thousands before her, she lived to see her chicks hatch out —within 50 feet of a gun club's firing line

(Left) THE bird's protective coloration is excellent

ONCE AGAIN the sweet trill of the upland plover echoes across our meadows. Its survival depends on the observance of wise conservation laws



(Below) SOON the mother plover lost her fear of the photographers and played her part with accustomed ease

[illegible] Before he had finished [illegible] I knew we had located another quailie nest.

It [illegible] squarely between the two houses of the skeet field, no more than 50 feet in front of the firing line where the gunners stand!

Perhaps that is why the hen plover was so lacking in the normal wariness of her kind. Having grown used to the thundering barrages of the skeet field, she may have cataloged us as quiet and well-meaning visitors by contrast.

The grass was short and sparse. Midway in the field stood a clump a little taller and thicker than that around it. There the plover nest was hidden. I inched my way out to the clump and no more than two yards distant I stopped and searched the tangled grass jungles for a sign of the brooding bird. She was there somewhere, I knew, a part of the light and shadow that wove its tangled pattern over the ground. But try as I would I could not make her out. There were no bird outlines there. Only the waving grass stems, and beneath them the tawny, black-and-gray-and-brown carpet of the dry field.

That perfect mimicry of a nesting game bird, hidden beyond belief among dead leaves or rushes or grass stems, is forever a fresh marvel to me. It is incredible that plumage can blend so indistinguishably into earth, that animate and inanimate can make so natural a union.

They seem to realize their advantage, too, those dull-robed females of field and thicket. Some instinct appears to warn them that safety lies in staying still, that so long as they are motionless the visitor is sure to pass them by. Else where do they find the courage to face the animal they dread most in all the world, no more than arm's length away, as steadfast and unmoving as birds of stone?

I gave up looking for my plover finally and shuffled a step or two into the grass clump. She flushed then, all but beneath my feet. She did not take wing. She ran off through the grass, piping her querulous complaints. A hundred feet away she found shelter in taller grass beyond the edge of the gun field, and we lost sight of her. But we could follow her by her low, anxious alarm notes. She circled us, calling anxiously, while we worked as quietly as we could beside her nest.

It was a deep bowl in the ground, lined sparingly with dry grass, holding the usual clutch of four eggs, pale buff in color, speckled lightly with warm brown.

[illegible] arranged two cameras on tripods. From the shutters we ran lines back to a low trap shelterhouse 20 yards away. There we waited for the quailie to come back.

We had only a little time to wait. She had almost no fear of us. The two cameras, so near to her nest, bothered her at first, but little by little she drew nearer to them, studied them carefully and dismissed them as a strange new but harmless part of the landscape. She walked up slowly, a few cautious steps at a time, craning her long slender neck this way and that, seeming more curious than afraid. Within a yard or two of the nest, she stood for a brief moment to make a final survey of the cameras. Then she crouched down among the grass stems and slipped back to her eggs like a swift shadow. Through the binoculars we could make out her head, lifted above the nest, turning warily from side to side as she studied the lenses that stared down at her and at the same time she kept watch across the field to make sure no new danger threatened.

One after another we pulled the strings. When we moved out to reset the cameras she kept her place until we were almost beside her. Then she ran off, more reluctant than alarmed. This time she did not bother to seek shelter in the tall grass. She circled in plain sight, and when we turned back toward the shelterhouse she came boldly toward the nest. Before we were in our places she was in hers, lost to sight in the grass clump, calmly covering the four buffy eggs once more.

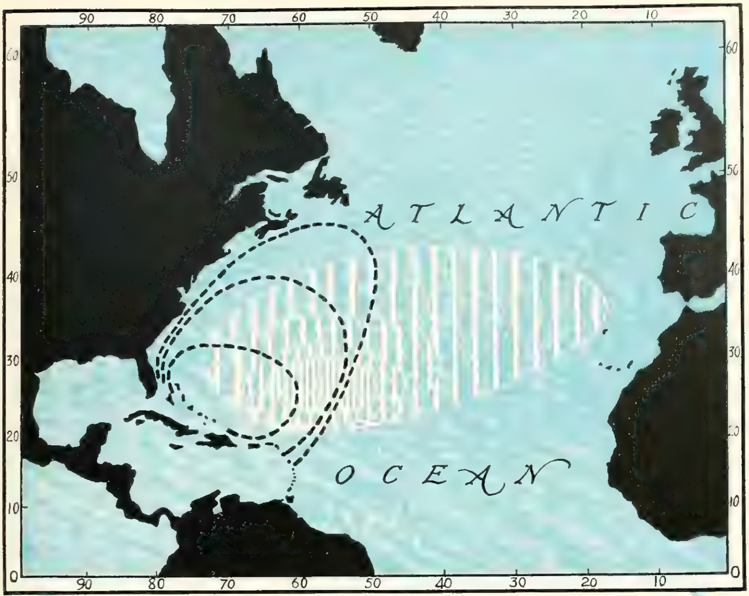
Before the week was done, despite the thunder of the skeet guns, she carried out her mission. The following Sunday morning the nest was empty, and fragments of broken shell told that it had not been raided. Somewhere in the tall grass of the near-by fields, I hope, the hen plover was leading four brown chicks.

The necessary laws

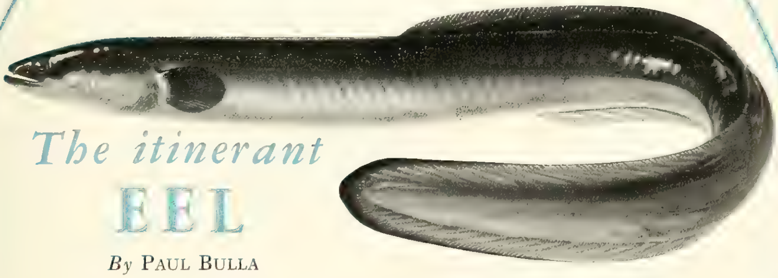
I have not seen the nest of an upland plover since, but I am well content. It is enough for me that the quailie is coming back, that I have been privileged to see and photograph this tall plover nesting once more in our southern Michigan meadows, that its mellow call is heard again in early June in many places where it was long absent.

Years from now, if all goes well and we accord this gentle bird the treatment it merits, we shall be able to say of the pasture plover: "This one we saved. For once necessary hunting laws were enacted in time."

To some small degree, maybe, that will lessen our shame that in the case of the pigeon and the heath hen and certain others we did not do as well.



The migration of American eels is shown by the dotted lines, that of European eels by the white areas



The itinerant EEL

By PAUL BULLA

From the weed-choked Sargasso Sea, newborn eels wriggle thousands of miles to their ancestral homeland—inland in North America or Europe, depending on their parentage. How do they do it?

OFF the North American continent, southeast of Bermuda and northeast of Puerto Rico, lies a vast tract of slowly swirling water known to mariners as the Sargasso Sea. Here, according to song and story the Gulf Stream is born, and here far below the weed-choked surface is the breeding and spawning grounds of our own fresh-water eel.

Here these strange fish have their rendezvous. In this sea within a sea they are born, and here, after years spent in far places, they return to reproduce themselves and die, for no spent eels have ever been seen, and adult eels have never been known to run upstream.

Of all the fish known to mankind, few have a more remarkable life history, and none have puzzled scientists for so long a time as have these snake-like denizens of the rivers and lakes of Europe and America. Down through the ages they have been a food delicacy in the European and Mediterranean countries, but centuries passed before their migratory habits and method of propagation were explained. Each autumn uncounted numbers of these slimy creatures moved downstream to the sea, where many were caught in the nets of fishermen awaiting their migration. But great numbers avoided this fate and disappeared never to return.

In the spring and summer of each succeeding year, tiny eel-like creatures appeared from somewhere in [illegible] through the Straits of Gibraltar [illegible] Mediterranean. [illegible] that [illegible] to the sea [illegible] when they [illegible] and simple fisherfolk alike by the fact that eggs of unborn eels were never found in the bodies of adults, [illegible].

[illegible] were advanced in explanation of how they were produced, ranging from spontaneous generation to the transformation of horsehairs into little eels. Aristotle, in the fourth century B. C., held that eels were born from earthworms, which were in turn produced from mud or damp soil. The early Greeks, failing to find spawn or male reproductive glands within the eels, named Jupiter as the father, as all children of doubtful parentage were [illegible].

Pliny the Elder, great Roman naturalist and author, declared with conviction that eels had neither masculine nor feminine sex. In accounting for their multiplication he concluded that they rubbed themselves against rocks, and the pieces scraped from their bodies came to life as little eels. He dismissed the subject as a matter for further controversy with the [illegible] that "they have no other mode of procreation." With the acceptance of such beliefs it is small wonder that centuries elapsed before such theories were dispelled and such superstitions overcome.

It was not until 1777 that the ovary of the eel was first recognized by Carlo Mundini, a professor of anatomy at the University of Bologna, thus definitely establishing a female sex. Ninety-five years later Reinhold Hornbaum-Hornschuch announced the discovery of a male in [illegible], and the enigma that had endured for over 2000 years was on its way to being solved.

But while these discoveries partly answered the riddle of their existence, where they came from and how they were produced still remained a mystery. [illegible] a German named Johann Jakob Kaup, in 1846, to find in the sea a small ribbon-like fish with a tiny head. Curious as to its species, he took it home and placed it in a bottle of alcohol. After labeling it *Leptocephalus brevirostris*, a name which exceeded the length of the specimen itself, he left it there to be forgotten.

Half a century passed before the subject emerged from the obscurity into which it had been relegated. [illegible] in 18[illegible], two Italians, Grassi and Calandrucci, found one of Kaup's little fish in the Mediterranean, but one much larger and more fully developed. This they identified as the leptocephalus or larva of the edible eel that inhabited the streams of the European continent. Well, [illegible] beginning the stage was set for a Danish scientist named Johannes Schmidt.

As director of the Danish Commission for the Exploration of the Sea, Schmidt sailed in 1906, on the first of many subsequent expeditions, to locate the breeding and spawning grounds of this specter of the deep. For fifteen years he towed nets up and down the Atlantic, taking specimens of leptocephali from the English Channel to Chesapeake Bay, and from Greenland to Puerto Rico. Over this vast area he collected and correlated sizes of eel larvae, carefully noting the latitude and longitude in which they [illegible].

He [illegible] that the [illegible] were growing as they moved from the place in which they were spawned toward the coast and their fresh-water homes. It followed therefore, that the smaller the larva found in any part of the ocean, the nearer such specimen must be to the place where it was born. After years of tireless effort he was able, through this method, to fix the breeding and spawning grounds of the European [illegible] and the American species (*Anguilla rostrata*) within the latitudes 20 to 30 degrees north, and longitudes 60 to 78 degrees west. He further established the fact that the European beds overlapped those of the American species.

But this discovery uncovered but one phase of the life cycle of the eel. During the period of growth in the waters of their home continent, both males and females are a uniform green to yellowish-brown above, shading to a pale dirty white underneath, and are called "yellow eels." When the migratory instinct asserts itself at the breeding stage, which is in the autumn when they are between the ages of seven and fifteen years, the sides of their bodies take on a metallic sheen and their backs become a deep black. This is their breeding dress, and they are then known as "silver eels."

Upon assuming this dress certain other marked changes take place in the females. Their snouts become sharp, the eyes larger, and the pectoral fins, just back of the gill slits, more pointed than usual. Although they have been voracious eaters all of their lives they cease feeding at this time and, leaving the lakes and rivers in which they have lived, move downstream to the sea. But while these visible changes have been taking place, it is not until after they have reached salt water that the ovaries mature. In fact no perfectly ripe female eel and only one ripe male has ever been seen. Upon arriving in the bays and estuaries of their home shores they are joined by the mature males that have been living there, and together they start the journey back to their birthplace, over 2500 miles distant.

It is not known how far below the surface they swim, but somewhere beyond the continental shelf they pass from the range of observation. Neither is it known how long it takes them to reach their destination, but it has been estimated that the eel requires about six months to make the crossing, swimming at the rate of one-half mile an hour. As the migration from the European continent begins in early autumn, and spawning starts in early spring at the breeding grounds, this estimate of the period of time for the trip seems to be justified.

Upon arrival at the breeding grounds, the European species find they must share it with their American cousins whose beds overlap their own, but extend westward from it. From Labrador southward to Panama and the West Indies, the "silver eels" from America have journeyed to the rendezvous in from one to two months after reaching salt water. Hundreds of fathoms below the seaweed-clogged surface of this tropical sea the eggs of both species are spawned; the females producing from five to 20 million tiny eggs, transparent and almost colorless.

Spawning begins in late winter or early spring, and a week or so after fertilization the eggs are hatched, and larvae of both species begin life with a length of about one-fourth inch. Ribbon-like in shape and so transparent that newsprint can be read through their bodies, they float for a time from 600 to 900 feet below the surface. Later they rise into the upper layers of water and slowly move northward. Reaching the latitude of Bermuda, a separation occurs. The larvae of the European species move eastward on the long journey back to their native shores, while their tiny American relatives turn toward the coast line of America.

During their first summer of life the European larvae are found in the western Atlantic. By the second summer they have reached the central Atlantic, and by the third they have arrived off the coastal banks of Europe. During their two and one-half years in the ocean they have attained a length of two to three and one-half inches, but still retain their flat, leaf-shaped larval form. They are now faced with a new way of life and must be prepared to meet it. In the course of the autumn and winter a metamorphosis takes place. They cease feeding, lose their larval teeth, shrink in depth and length, and become elvers, or little eels. While they are shaped like their parents in miniature, they are still transparent, and so are known as "glass eels."

Our American eel has a shorter larval history. Here again the timing is perfect, for it reaches its home shores and the elver stage of existence in about one year.

After the transformation from larva to elver, the females of both species ascend the fresh-water streams of their native land to live their lives in the interior until the moment when the migratory instinct drives them back to the sea. In these journeys upstream they use pipe lines and sewers and clamber over falls and surmount dams to reach their destination. The males however, remain in the brackish waters of lagoons and estuaries, where they grow to maturity and await the downstream migration of the females.

As eels have been found in ponds having no outlets or inlets, it is believed they will travel overland to reach these oases, choosing nights when the grass is damp for the journey. As there is no evidence to establish this presumption, their presence in these isolated waters is still something of a mystery. They are also at home in high as well as low altitudes, having been found in Swiss lakes 3000 feet above sea level.

All eels in the headwaters of large streams are found to be females. As a rule they lie buried by day in the muddy bottoms where there is still water, and venture abroad to feed at night. Being scavengers and omnivorous, they will eat almost any available food, either living or dead. They have even been known to eat their own kind.

Female eels average from two to three and one-half feet in length, but have been known to reach four feet and weigh as much as sixteen and one-half pounds. Males average around fourteen to eighteen inches in length, but never grow larger than two feet. The vertebrae of this fish mark the only difference between the American and the European species: the former have an average of 107 segments, while the latter averages 114.

Differing from their salt-water cousins, the lower jaw of both species projects beyond the upper, while the large mouth gapes back to a point even with or somewhat behind the eyes. On the side of the neck are gill slits with upper corners on a line with the center of the base of the pectoral fins. A single fin, soft and without spines, extends along the back, around the tip of the tail, and forward on the underside of the body. There is no separation into dorsal, caudal, or anal parts. After the third or fourth year of life, eels develop small scales that are embedded in the skin. These are covered with a coating of slimy mucous, which has given rise to the simile, "as slippery as an eel."

Perhaps the most intriguing phase of the life cycle of this unusual fish is that neither European nor American elvers have ever been known to appear off the shores of any country but their own. This fact immediately presents two puzzling questions that challenge the imagination.

1. What causes the immature larvae of the European species to move eastward from the spawning grounds, while its American cousin works toward the west side of the Atlantic?

2. How does it happen that the timing is perfect for both species to reach the elver stage within a few months after arriving off the coast of their home continent?

These may be answered in part by the difference in their individual larval histories.

While the European larva requires from two and one-half to three years to reach the elver stage of development after life begins, the larval stage of the American species is terminated in about one year. This time element not only acts to keep the two species distinct, but makes it practically impossible for either to survive in waters other than their own after metamorphosis takes place.

Should the larvae of the European eels move westward they would reach the American coast line still in an undeveloped larval stage; while the American species traveling westward would reach the elver stage somewhere in the western Atlantic when the time arrived for them to seek fresh-water retreats.

A geographical cause for their distribution is advanced by Doctor Schmidt, who points out that the center of production for the American eel lies farther west and south than the center of the European beds. These, together with the movement of the ocean currents as an aid to the journey in the early stages of larval development, must be considered as causes directing the two species each to its own side of the ocean.

While much has been learned of the habits of these sluggish, sedentary fish, since the turn of the century, much remains unexplained.

With a singleness of purpose and an unerring instinct that has confused scientists, untold thousands have deserted their home waters each autumn to seek adventure in a tropic sea and to keep their rendezvous with death. Weak and immature, their progeny is cast adrift far from their native land and, unguided, these feeble swimmers travel a road over which they have never journeyed, to reach their home continent.

Truly, the eel is one of the greatest of marine mysteries.

The largest known Crocodil

By BARNUM BROWN

Today North America has but a single species of crocodile. Past ages beheld many and varied forms of this tail-slashing reptile, but none was as huge as the 45-foot Texas giant **which competed with the dinosaurs**

I [illegible] mous prehistoric crocodile head recently found in Texas.

The American Museum-Sinclair Expedition [illegible] discovered this huge fellow in the "Big Bend" region of southern Texas just north of the Mexican border. Other bones in the same rock show that dinosaurs new to science were fellow countrymen of this great reptile some 70 million years ago in the land that is now Texas. Some of these dinosaurs were likewise of gigantic size.

When discovered, the remains of the crocodile were only an incoherent mass—large broken sections of the skull and jaw, jumbled together and completely embedded in hard stone. It took eight months of continuous, difficult work in the laboratory for Roland T. Bird to chisel them out and prepare *Phobosuchus* for study and exhibition.

With a complete lower jaw of a crocodile or alligator it is possible to compute quite accurately not only the length of the skull but that of the entire animal. The estimated length of the body is based on the ratio of one foot of body to each inch of mandibular tooth space, a ratio which is fairly constant among living crocodiles. By this reckoning, the huge crocodile, when alive, would have measured more than 45 feet in length. As a further check, approximately the same length is computed by comparison of the length of the single existing vertebra (fourth dorsal) with that of the similar bone in the modern crocodile.

The beast could open his mouth three feet, disclosing large, round teeth, several of which were five and six inches long and two inches in diameter. As restored, the skull is six feet long and three and one-half feet wide at the back. A close approximation of its entire form is possible, because we have almost the whole left side of the lower jaw, part of the right side, both sides of the snout, and the front of the head. The surface sculpturing of the exhibit is based on the modern crocodile.

The first known specimen of this kind was found in Montana in the Judith River beds, probably of the same period. This consisted of two large vertebrae, ribs, pubis, skin plates two inches thick, and a few other fragments. But previous to our discovery we had no idea of the size or form of "Phobo's" skull, and it seems most fitting that this biggest "croc" skull should be found in Texas, our biggest state.

Crocodiles are of world-wide distribution throughout the tropics and subtropics, and in past ages they were far more numerous and varied than at present, many kinds having dropped along the wayside. Today North America has but a single species of crocodile and a single species of alligator. The crocodile is readily distinguished from the alligator by its more pointed head and by the way the fourth pair of mandibular teeth fit into notches on the side of the snout—as indeed they do in this fossil skull.

Within the memory of man there were alligators in Florida that measured fourteen and fifteen feet in length, but now a twelve-foot specimen is rare. The American crocodile is still smaller. The Asiatic marine crocodile is the largest living form. Some specimens reach a length of 33 feet, but their skulls are pygmy when compared to this fossil giant from the Rio Grande.

Lush semitropical vegetation covered a region rich in rivers, marshes, and lakes when our giant croc lived in the Big Bend country. Hordes of duck-billed, horned, and armor-plated dinosaurs as well as prehistoric turtles inhabited the shores. There were doubtless extensive woodlands, too. And the largest known fossil tree, measuring fourteen feet in diameter, is from this region. Climatic conditions evidently favored the huge sauropod dinosaurs here long after they had died off in the northern United States, where their remains are better known.

In the thin layers of ancient lake deposits encircling the Chisos Mountains there are literally thousands of dinosaur bone fragments. Strange to say, there are rarely any connected parts of skeletons. Having seen this gigantic crocodile, one cannot help playing with the idea that he and his kind may have been responsible for much of the breakage among the dinosaur bones.

Today this region is one of wild, picturesque beauty, semidesert in character but sparsely settled with occasional cattle, goat, and sheep ranches, miles apart. The entire area is dominated by the jagged igneous peaks of the Chisos Mountains, approximately 8000 feet high on the Texas side of the Rio Grande, and by the higher Del Carmen range on the Mexican side.

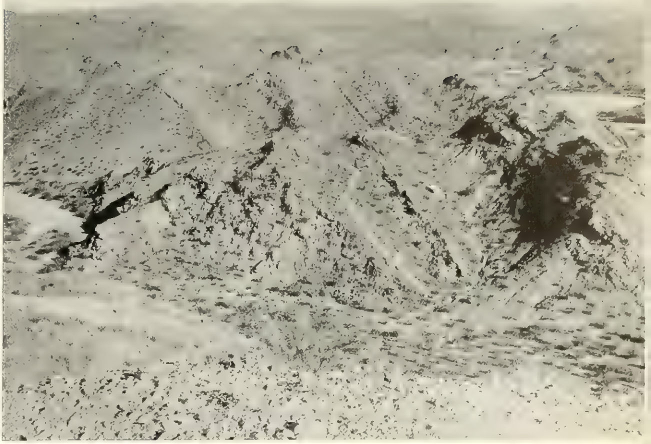
Steps are now being taken to make this Big Bend region one of our great National Parks—in fact, an International Park, for the Mexican Govern-

A THREE-FOOT YAWN! Barnum Bro
(left) records Phobo's measuremen
assisted by Roland T. Bird, who restor
[illegible]

ment proposes to set aside a similar area that will connect with it south of the Rio Grande, forming an international playground.

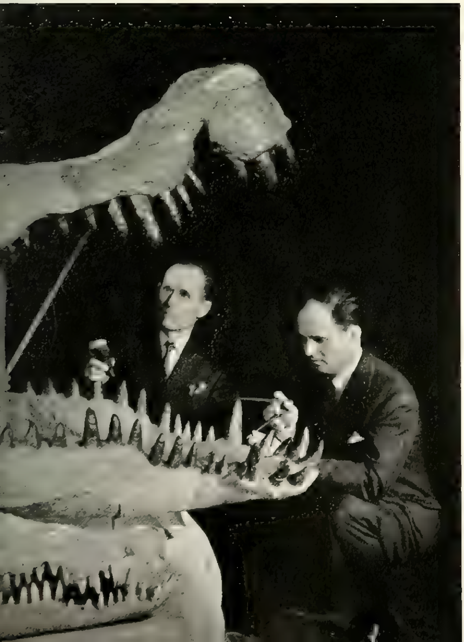
The Mexican side is rich in cave dwellings of prehistoric Indian peoples dating from the Basket Makers. In the Mexican villages along the Rio Grande, particularly in Boquillas, one can find Mexican food at its best. Historically, many fascinating episodes have taken place on this border region. It was at Glen Springs that one of Pancho Villa's marauding contingents crossed the border, and just south of the Rio Grande is one of the oldest settlements in North America.

Both the Mexican and Texas parks of this area will be unlike any of our other great parks. The region is fascinating to the traveler who can carry his own accommodations and water, and in the wilder places the adventurer may always have the lure of finding some new form of ancient life such as our champion crocodile, *Phobosuchus.*



ITS HOME was fittingly in our biggest state. This arid region in the Big Bend country is typical of the beds in which *Phobosuchus* was found. The trail was made to remove other fossils; one of which is visible at bottom

the skull, and Erich Schlaikjer, paleontologist. Phobo's skull dwarfs a modern crocodile's *(below)*. The American Museum-Sinclair Expedition's prize took eight months of reconstruction



WHEN *Phobosuchus* lived in southwestern Texas, vegetation was semitropical and luxuriant. Today only heavy rain changes the dry Banta Shutin Gorge into a river

Photos by R. T. Bird

CAMPING ON ANCIENT TRAILS

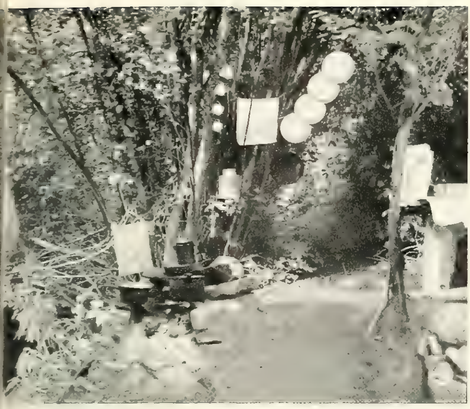
By N. C. NELSON

[illegible]

HOME is where the diggings are good. The Museum's last small tent proved a boon when the idyllic Indian summer yielded to daily thunderstorms and snow

IN THE TOWERING CLIFFS above the camp lay the caves which were occupied by Indians in early historic days. These two joined behind the massive pillar

[illegible]



Beside the clear, cool waters of Sage Creek in south central Montana. No camp ever seemed more promising—for two days. The author's wife managed to outwit the pack rats by hanging the sack of potatoes by a wire *(left)*

The human side of an expedition to explore the caves of the vanished buffalo hunters of Montana, and how their unwritten history is being pieced together

Camp life is normally nothing new to a museum curator. It is part of his job and is accepted seasonally as a matter of course. But, the times being what they are, it was somewhat of a surprise after softening up in the Museum laboratory for fourteen years suddenly to be sent to the Rocky Mountains to dig out some promising Indian caves.

From all accounts it looked like a lark in paradise. The locality to be worked was well away from centers of white settlement on the sparsely populated Crow Indian Reservation in southern Montana. In addition the place was well up a mountainside, suggestively cool and comfortable in contrast to the scorching summer heat of New York City. The caves themselves were in the walls of a picturesque canyon drained by a fine cool stream lined with trees and bushes. The best time of the year, as vouched for by both local residents and several experienced fellow workers at home, was September and October, which form part of what is usually a long idyllic Indian summer. In short, in the words of the colleague who selected the caves the year before, "If Nelson doesn't have a good time, it will be just his own fault."

(Below) **The work begins,** a strenuous task involving the careful examination of over 100 tons of floor debris

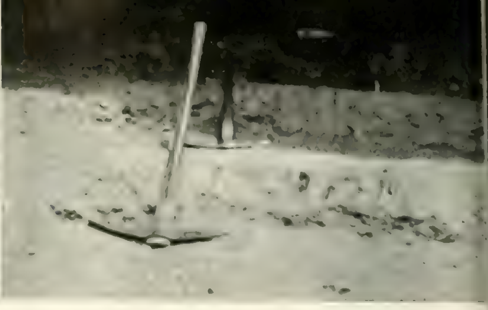
How to outfit under such beguiling circumstances seemed at first a problem. The preliminaries were easily solved, however, for when I came to look in the storeroom for camping paraphernalia, all I found was a 6 x 6 foot silk tent and a single thin mattress. The rest had been taken by other members of the staff who had previously departed for Mexico and South America. To be sure, there remained also one decrepit old folding cot; but even if not a luxury, to take this meant buying another for Mrs. N. This thought was a trifle painful, because with limited funds and promising archaeological prospects the obvious thing was to outfit lightly and thus save money for excavations. Well, why not sleep on the ground? The cot was too long for the tent anyway. And so I took my own lightweight sleeping bag—once carried on my back for several hundred miles—and Mrs. Nelson was resourceful in improvising something for herself.

On August 10th, with the help of Mr. Oscar Lewis and other Museum friends from Billings, we pitched camp in the shade of a birch and chokecherry thicket within a few feet of the clear, cool waters of Sage Creek. No camp was ever more promising. The altitude was about 5000 feet, making us at first a little short of breath. But the noon temperature in the shade was only about 85 degrees, and the refreshing mornings saw it down to 44, low enough to make us enjoy the campfire. One of the two large caves for which we held permit from the U. S. Department of the Interior was visible in the towering cliff directly above us, and the other was less than a mile away.

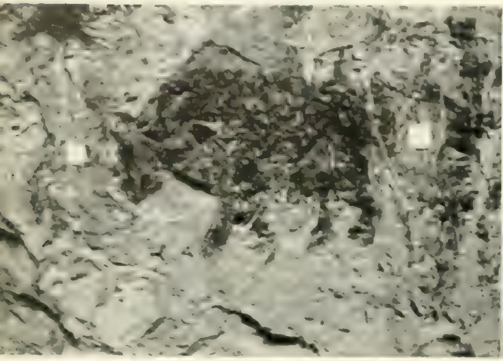
Work began immediately and, except for the wily pack rats which stole everything they could carry away, all went well for two whole days. Then, on the 12th, the seasonal, almost daily, thunderstorms began. They never let up until September 7th, when they ended in a heavy snowstorm! And this latter, while of course "unusual," was no accident, because before we left for home at the end of September we experienced two more such snowstorms, one of them rather devastating. Incidentally, as if for good measure, the thunderstorms, which had a way of descending a little before supper was ready — drenching everything, including our enthusiasm—were interspersed with just ordinary rainy spells lasting from 24 to 36 hours. It is to be admitted that we could easily have escaped all these inconveniences of weather by moving into a cave; but the task of carrying wood, water, and outfit some distance and up 100 feet or more seemed too much. Besides, had we not been assured of "fine weather"? Still, we have decided that next time we go camping in Montana we shall bring winter garments, a big substantial tent, rubber boots and slickers.

But let it not be supposed that mere camp problems seriously interfered with archaeological pursuits. Work in fact went on in comparative comfort in the all-too-dry caves. Only once were we actually compelled to leave camp and seek shelter at a neighboring ranch house.

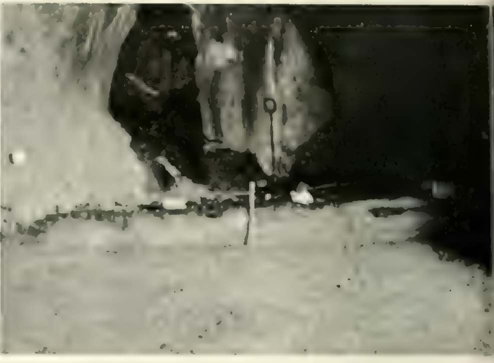
THE EARTH of a once inhabited cave is sifted for small objects such as beads that might otherwise be overlooked



MATERIAL is removed layer by layer, because what is deeper is older. Here, however, the relics were at one level



WALL PAINTING of bison, indicating that the natives respected the animal which civilization almost exterminated



VESTIGES of an early fireplace can be seen where a dark stripe is exposed at the far end of the section above

IN THE WALLS of Sage Canyon, about four miles long, 45 caves were counted. Most were smaller than the large one at right but nearly all were suitable for human habitation

[illegible]

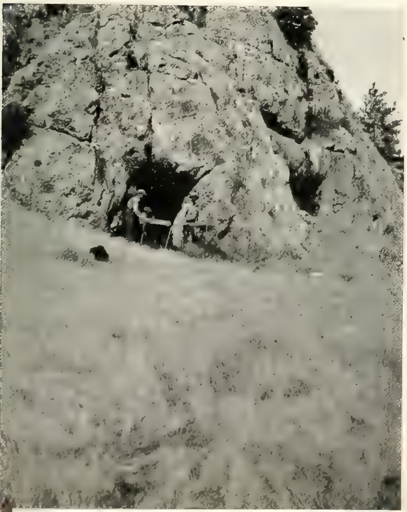
The localities under investigation were two picturesque canyons, both cut into limestone formations and both heading southeastward into the foothills of the Pryor Mountains, the main ranges of which are incorporated in the Custer National Forest immediately to the south. Our principal concern was Sage Canyon, a moderately wide gorge about four miles long. In its opposing cliffs we counted no fewer than 45 caves, varying in size but all more or less suitable for human habitation. Three of them showed painted representations of human, animal, and geometric figures done in red and black on the rear walls. The two largest caves—one of them with a nearly level floor space exceeding 150 square meters—were cleared of culture debris, and some 25 additional smaller shelters were tried out as future possibilities. Thus in all, some 380 square meters of cave earth were excavated to an average depth of over a foot and carefully screened. What we found consisted mainly of chipped and ground stone implements, fragmentary animal bones, and—somewhat disappointingly—a few objects of white man's origin. The principal caves had obviously not been inhabited for any length of time. Also the aborigines, like ourselves, appear to have been short of breath, or else lazy, for the run of artifacts showed clearly that the occupants had preferred living in tents on the spacious canyon floor itself and in the few conveniently low-lying small caves to the really commodious shelters which necessitated a climb of 100 feet or more. The only explanation that suggests itself is that the canyon was frequented merely during the pleasant short summer seasons.

The other gorge, examined on invitation of the Crow Reservation Superintendent, Robert Yellowtail, lies about ten miles to the north and is known as Pryor Canyon. Here within a mile and a half of the entrance one large and several small caves were tried out, with negligible results. Paintings were found on the walls, but the floor deposits yielded no visible streaks of culture debris, though stray artifacts were sometimes present. However, a redeeming site turned up in the shape of a large artificial stone heap, or cairn, lying near the mouth of the canyon, at the base of a prominent cliff variously named as Arrow Rock, Evil Rock, and Medicine Rock. This cairn, about 35 feet across and five feet high, showed superficial traces of artifacts.

To make certain of its nature and contents, a trench was cut fully halfway across the mixed earth and rock composing it. The relics found were in part similar to those from the caves but also included a considerable range of ornamental objects, as well as some 200 potsherds—all confined to the upper half of the deposit. Why this and other smaller rock piles in the vicinity were here and why this one alone contained artifacts are still problems. The Crow Indians whom we asked about it professed total ignorance; but, in the absence of any apparent practical functions, this cairn must have served some ceremonial purpose. The ornaments and the food remains represented by animal bones presumably were offerings.

Summing up our findings, the excavated cave deposits consisted nearly everywhere of a single thin layer of blackish culture debris, lying directly on the surface of the natural cave earth floor, but covered usually by a considerable thickness of recent cattle dung. These black layers alone contained all that we found of archaeological interest. Most conspicuous were a few fireplaces and numerous fragmentary animal bones lying about as proof of what had been prepared in the way of food. Bison, elk, and deer must have been the mainstay; but the wolf, mountain lion, beaver, marmot, and other small rodents were present, while of birds there were only bare traces. Of manufactured articles, chipped stone implements were in the lead, as represented by arrowpoints, spearpoints, drillpoints, knife blades, sidescrapers, and endscrapers, as well as numerous reject cores and flakes. Ground stone implements included natural hammerstones, upper

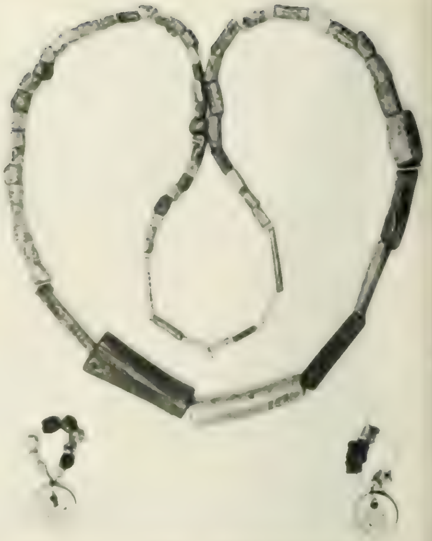
(*Below*) ONE of 25 rock shelters in which test digs were made to estimate possibility for future excavation



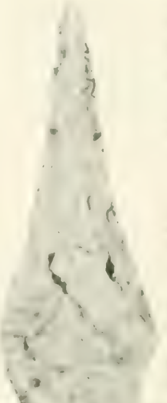
(*Above*) A ROCK HEAP which contained numerous relics and which evidently had religious meaning for the people who made it. The modern Indians knew nothing of its origin [illegible] it nevertheless revealed to us the main features of the [illegible] tirely on what wild nature supplied. Clearly they [illegible] tepees and who in their permanent winter habitats at lower altitudes probably lived in substantial earth lodges, like their neighbors out on the plains. They hunted such game as the locality afforded and could have fished in the passing stream, though there was no proof that they did so. Apparently the bison, being here perhaps relatively scarce, was stalked by the lone hunter. But elsewhere, not far away and scattered all over western Montana, there are said to be hundreds of so-called "bison drive dumps," as evidence of communal hunting. These "dumps," consisting chiefly of masses of bison bones, occur at the base of cliffs over which the organized pursuers drove the stampeding herds to their destruction, later, if necessary, dispatching the maimed creatures with clubs or bows and arrows. Ten years ago two such sites, littered with arrowpoints of a small, side-notched type, were excavated and reported upon in NATURAL HISTORY XXXII, [illegible] Dr. Barnum Brown of the American Museum. But whatever method our cave visitors used they did not live on meat alone. The presence of mealing stones shows that they doubtless also gathered roots, seeds, berries, and other fruits. Of the 1500 native vegetable products said to have been used as food by the American Indians, many are available in Montana. We found the plums and chokecherries in season and they were both plentiful and [illegible]

One more touch must be added. The quest for food, while naturally of first importance, did not take up all their time. The cave paintings suggest other interests. In addition, objects for personal adornment, derived mostly from the cairn, comprise a considerable variety of beads and pendants. Most of these are made of bone; others are of shell, including olivella and dentalium, suggesting trade connections with the Pacific Coast; and a few are of stone, for example, steatite and turquoise. Two ornamented dice or game pieces reveal the makers as perhaps all too human. Incidentally, the cairn, like the caves, also yielded a few items of foreign origin. Among these were arrowpoints of iron and copper, pendants of copper, glass beads of various colors, and a bronze medalet dated 1864!

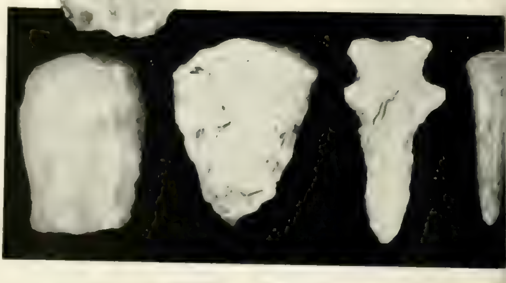
The main conclusion to be derived from our brief survey, as viewed in the light of stratigraphic results recently obtained in Pictograph Cave, less than 40 miles away, near Billings, is that the Sage and Pryor canyons were frequented for only a brief period not long prior to historic times. Who the visitors were can probably never be definitely established. Quite likely they may have been members of the Shoshonean tribes, who are thought to have ranged over the territory in early historic days. At any rate, available information suggests that they were not the Crow Indians now dwelling on the Reservation.

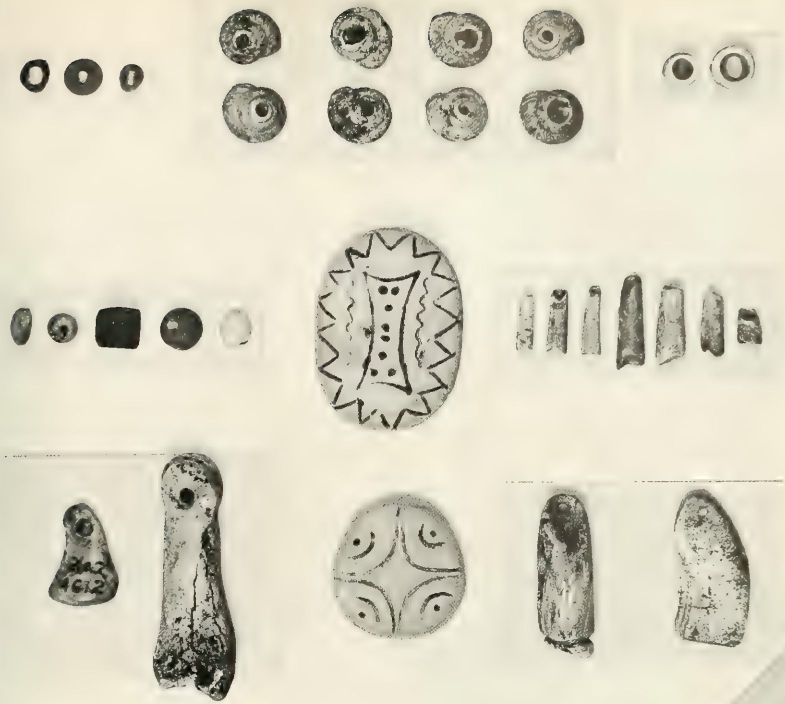


MANY BEADS of bone, stone, and shell were found, some of which are grouped above in the form of a necklace



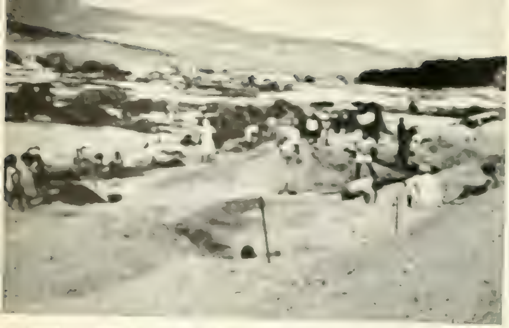
CHIPPED stone arrowheads and spear points were the most plentiful manufactured articles. Though the two center points on the opposite page would seem small for the purpose, there is evidence indicating that this type may have been used for hunting buffalo





TWO DICE or gaming pieces are shown above, surrounded by pendants and beads, showing that the people did not devote all their energies to the business of securing food

ONCE USED to grind roots, seeds, and berries by a primitive campfire, the upper and lower mealing stones at right become one more clue to the story of a people unknown even in the traditions of surviving Indians



(*Above*) IN THE SEARCH for diamonds, the *garimpeiros* (diamond seekers) wait for the dry season (April to November) when the river bed is exposed. Then thousands, sometimes entire families, prospect for a favorable location to put in a season of diamond hunting. This photograph represents the Rio Jequitinhonha in Minas Geraes during the dry season. During other times of the year, the river covers all the protruding boulders along the entire valley

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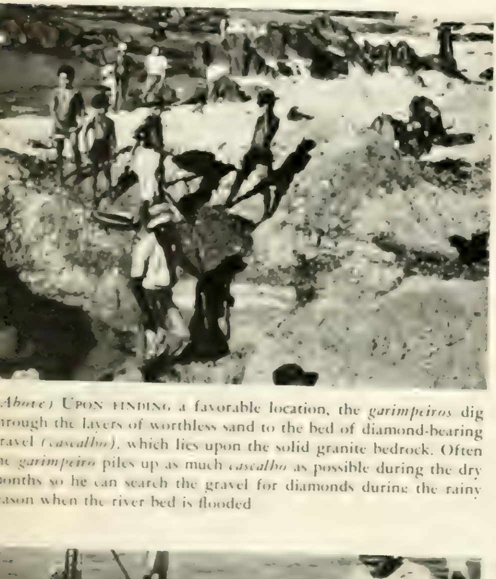
By F

PHOTOS BY THE AUT

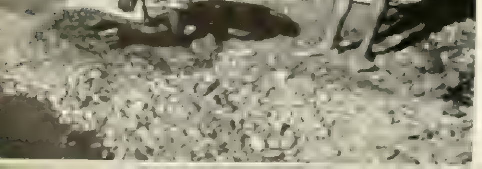
A changing world market and the needs of war-time industries give new meaning to the largest diamond fields in the Western Hemisphere

Brazil has been yielding diamonds since 1721 and now produces about three per cent of the world's supply. Because of the increased need of diamonds in war industries, a source in the Western Hemisphere yielding even this percentage is important. South Africa produces about 90 per cent of the total.

Brazil's diamonds come from numerous rivers draining the high and dry region of the central plateau, and as many as a dozen of the states produce them. Matto Grosso, however, yields the greatest quantity, while Minas Geraes enjoys the greater record for large gems.



Above) UPON FINDING a favorable location, the *garimpeiros* dig rough the layers of worthless sand to the bed of diamond-bearing ravel (*cascalho*), which lies upon the solid granite bedrock. Often e *garimpeiro* piles up as much *cascalho* as possible during the dry onths so he can search the gravel for diamonds during the rainy ason when the river bed is flooded



(*Left*) THE PILES OF GRAVEL are first screened so as to eliminate large pebbles. Each stone is examined before being thrown away. The small gravel is then examined very carefully for diamonds. Occasionally small pebbles of cat's-eye, aquamarine, tourmaline, and topaz are also found

(*Right*) THE FINE MATERIAL of the gravel is panned in the large wooden *batea*. Gold is always present, and occasionally small diamonds are obtained in this last washing, associated with a heavy black magnetic sand. Practically all the rivers of the diamond-bearing regions contain gold

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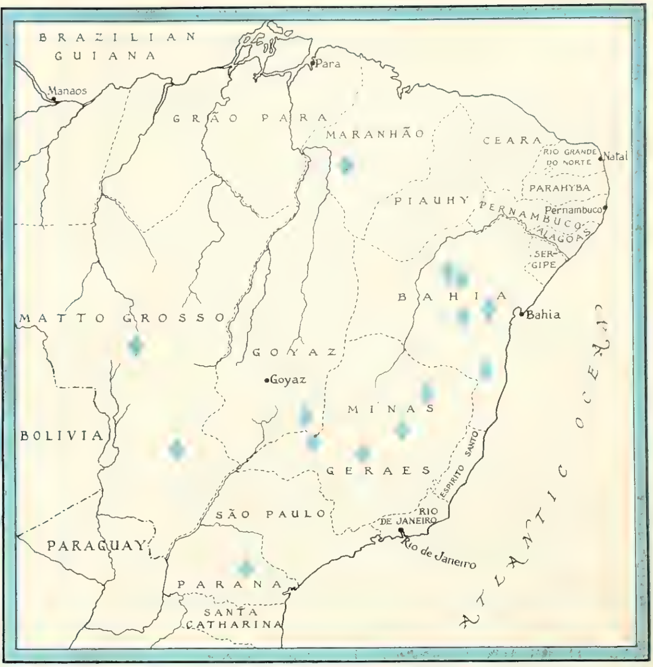
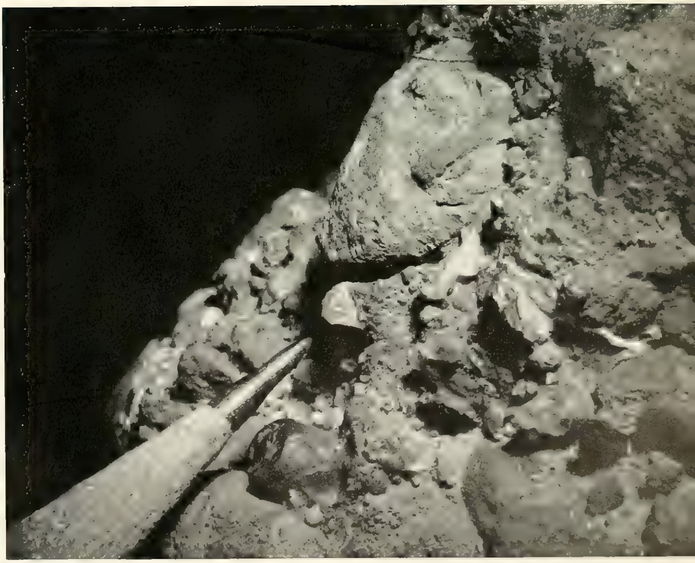

BRAZILIAN GUIANA
Manaos
Para
GRÃO PARA
MARANHÃO
CEARA
RIO GRANDE DO NORTE
Natal
PARAHYBA
PIAUHY
PERNAMBUCO
Pernambuco
ALAGOAS
SERGIPE
BAHIA
Bahia
MATTO GROSSO
GOYAZ
Goyaz
MINAS GERAES
BOLIVIA
ESPIRITO SANTO
SÃO PAULO
RIO DE JANEIRO
Rio de Janeiro
PARAGUAY
PARANA
SANTA CATHARINA
ATLANTIC OCEAN

AMNH photo by Charles H. Coles



A SMALL DIAMOND can be seen embedded in this mass of gravel, which is made up of pebbles and grains of basalt, actinolite, quartz, hematite, rutile, and sand. The diamond is rounded and lacks crystal faces. This reveals that it has traveled a great distance from its source

THE [illegible] OF DIAMONDS: Utility competes with beauty in the modern diamond market, and these crystals are destined for use in polishing, cutting, and drilling steel and rock, and as dies for the drawing of wire

A—The rarest and most desirable type of industrial diamond is ballas. This South African specimen is of tremendous size, weighing 330 carats. Ballas are round masses of small radiating diamond crystals, concentrically arranged. Because of their structure, they have no cleavage and are exceedingly tough.

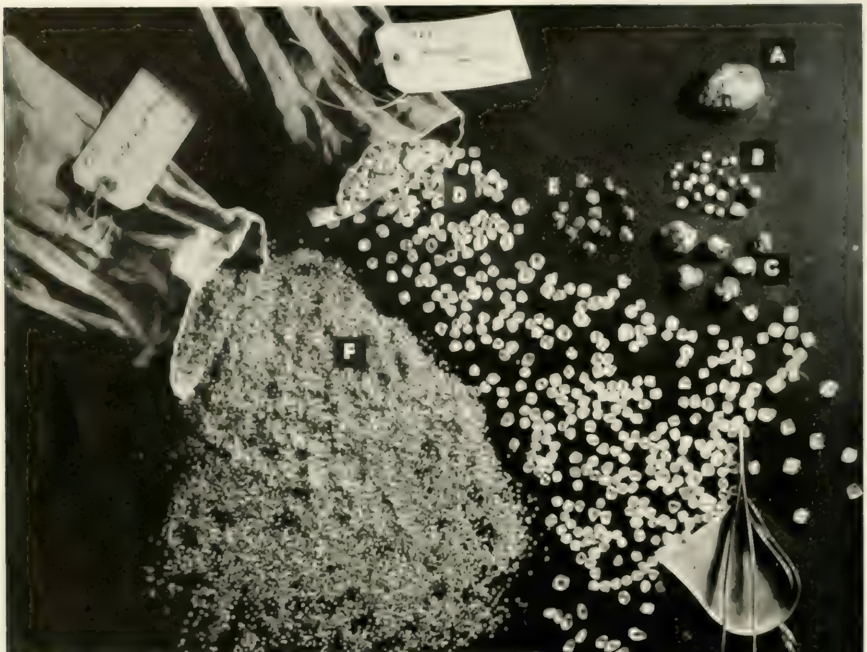
B—Smaller ballas like these are more adaptable to different uses than the larger ones. Brazilian ballas are far commoner, also rounder, more compact, and tougher than those from South Africa

C—Ballas from the Premier Mine, South Africa.

D—Bortz are diamonds of selected quality which are rejected as gems because of undesirable yellow or brown tints or because of black carbon inclusions or flaws. They are generally single octahedral or dodecahedral crystals which cleave easily.

E—Black diamonds, or *carbonados*. These are found only in Bahia, Brazil. They are black or gray; inferior qualities are porous and often resemble pieces of coke or slag. They are tougher than bortz and more adaptable to special uses, because they have no cleavage.

F—Small bortz. These are suitable for core drills used in oil drilling and mine sampling.



(Left) A STRONG STREAM of water is used to wash the soft, decomposed material at the Serrinha Mine near Diamantina. The method is similar to the hydraulic system for washing gold in Alaska. This mine is unique in Brazil, for almost all Brazilian diamonds are found in rivers

AFTER POWERFUL hydraulic action loosens the diamond-bearing material, long wooden flumes *(at right)* carrying the *masse* to the mill, where a series of revolving screens eliminate coarse pebbles. Then the remaining material is run through a rotating drum containing steel balls, known as a "ball mill." This crushes the harder lumps and discharges worthless material. The heavy materials drop to the bottom. At the end of each day, the residue is sorted by screening or running through a vibrating table to separate further the different constituents from the diamonds. These diamonds are sharply crystallized and of fine gem quality, showing no evidence of river wear

A SMALL WATER-WORN diamond in quartzitic sandstone: a type of occurrence which puzzles the geologist. This ancient formation underlies a large area in Minas Geraes. Diamonds are found in it near Grão Mogol, about 150 miles northeast of the Serrinha deposit described above, which lies within the quartzite formation

AMNH photo by Charles H. Coles

(Below) FLEXIBLE ROCK. Not far from Brazil's deposits of the hardest substance known to man are found specimens of the "softest" rock in the world. This is among the oddest geological curiosities on earth. Slabs of the sandstone several inches thick can be bent back and forth with ease. The rock gives forth a sound when it is bent. Deposits are known in other localities, but the finest is the Brazilian

THE PRESIDENT GETULIO VARGAS DIAMOND. Tipping the jeweler's scales at 726.6 carats, it edged out the Jonker Diamond by a mere fraction of a carat to become the third largest diamond in the world. Two *garimpeiros* were greatly enriched when they discovered it in 1938

AMNH photos by Charles H. Coles

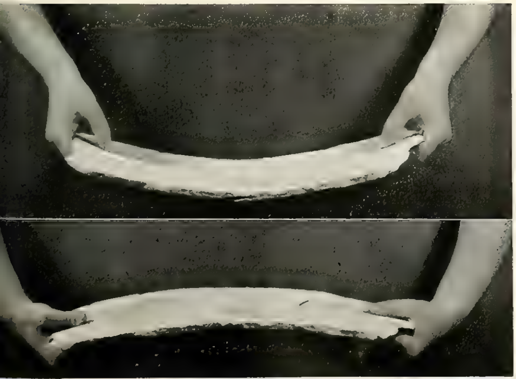
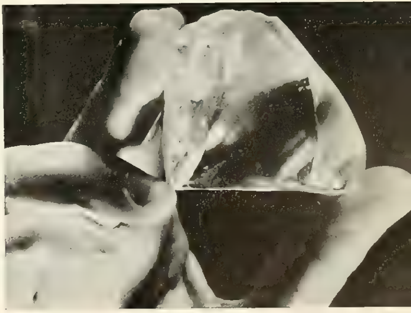
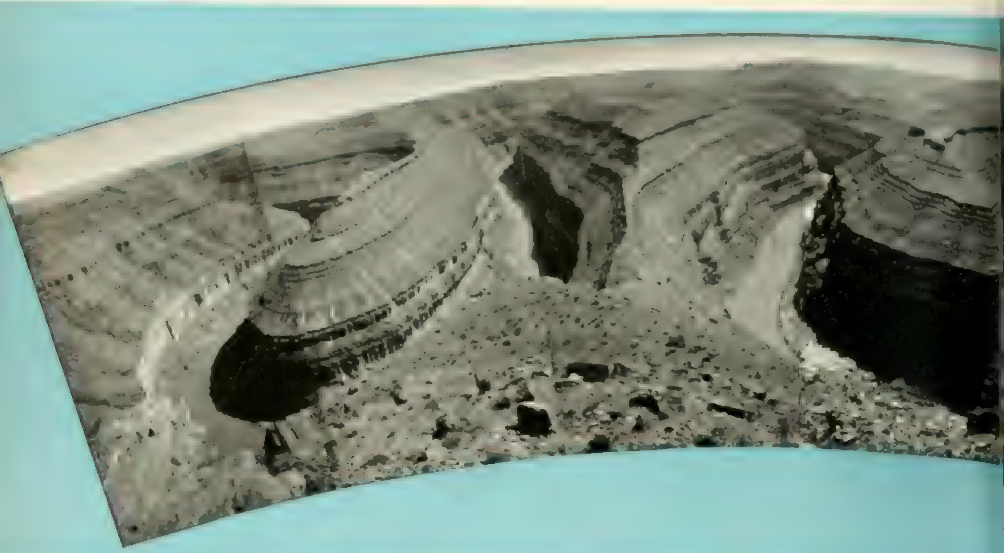


Photo from Oswaldo Dantes



THE GOOSENECKS

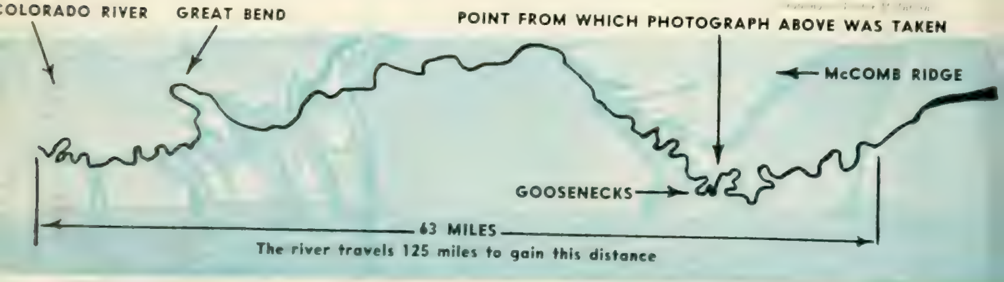


By H. E. Vokes

Rivers can do strange things—the Mississippi was even seen to flow backward on its course—, but the San Juan in southeastern Utah, once a commonplace meandering stream, "dug-in" to form one of the most spectacular serpentine canyons in the world

DECEMBER 16, 1811: it was night and the little hamlet of New Madrid, in southern Missouri, was blacked out in peaceful rest. Shortly after two in the morning, however, there arose a rumbling roar—a noise like that of thunder, but with a deeper and more sustained, menacing note. And then the ground began to rock! Shouting their terror, the astonished backwoodsmen rushed from their cabins. They saw the Mississippi River flowing backward, uphill, in relation to its normal direction of flow! Never had anyone seen anything like that before.

In the succeeding weeks, they were to become all too familiar with the jarring and shaking of their earth. For more than a year it continued to be almost


COLORADO RIVER
GREAT BEND
POINT FROM WHICH PHOTOGRAPH ABOVE WAS TAKEN
McCOMB RIDGE
GOOSENECKS
63 MILES
The river travels 125 miles to gain this distance

OF THE SAN JUAN

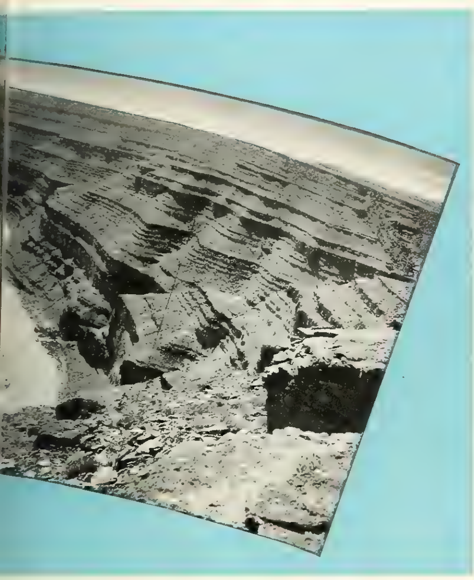


Photo by Weyer

constantly convulsed; within the first three months there were more than 1800 distinct shocks. The heaviest quake of all occurred on February 7, 1812, when many trees were actually snapped off by the jarring motions. At New Madrid the graveyard slid forward until it rested in the bed of the Mississippi River, and the ground on which the town stood, as well as the river bank for fifteen miles above it, is said to have sunk almost eight feet below the former level. These people were living in the terror of one of the greatest earthquakes of historic time. They saw the earth open in great fissures, through one of which a near-by small lake was suddenly emptied of its waters. But they did not again see the Mississippi River flow backwards.

What had caused it to flow in that direction on December 16th? The evidence is inconclusive. There were no trained observers in the region during those pioneer days, and there were no modern scientific instruments to record the precise nature of the shocks. But it does seem most probable that there had been a local and temporary uplift of some section of the river bed during the period of that first great shock. Normal conditions were apparently soon re-established, and the river resumed its usual direction of flow. But what if they had not been thus re-established? What if the land had even continued to rise?

If the violent and abrupt uplift had continued as it began on that long-distant night, the Mississippi River of today would probably be emptying through the Chicago River into Lake Michigan, and a shorter, much smaller stream would now be passing through the channels near New Orleans.

But if, on the other hand, the rate of the uplift had been slow, as imperceptibly slow, perhaps, as the uplift which is even now going on along our northern Atlantic coasts, it is probable that the current of the Mississippi River would have been able to cut its channel as rapidly as the land was lifted. The river would then flow between banks of increasing height; and if the amount of the uplift were great enough, a time would come when the Mississippi would flow through a deep, steep-walled canyon.

This didn't happen to the Mississippi River. But it did happen to the San Juan River of southern Utah. Once this river was a stream much like the Mississippi. Some two million years ago it, too, meandered back and forth across a broad flood plain, tracing a tortuous, snake-like course as it lazed along on its slow voyage to the Colorado River.

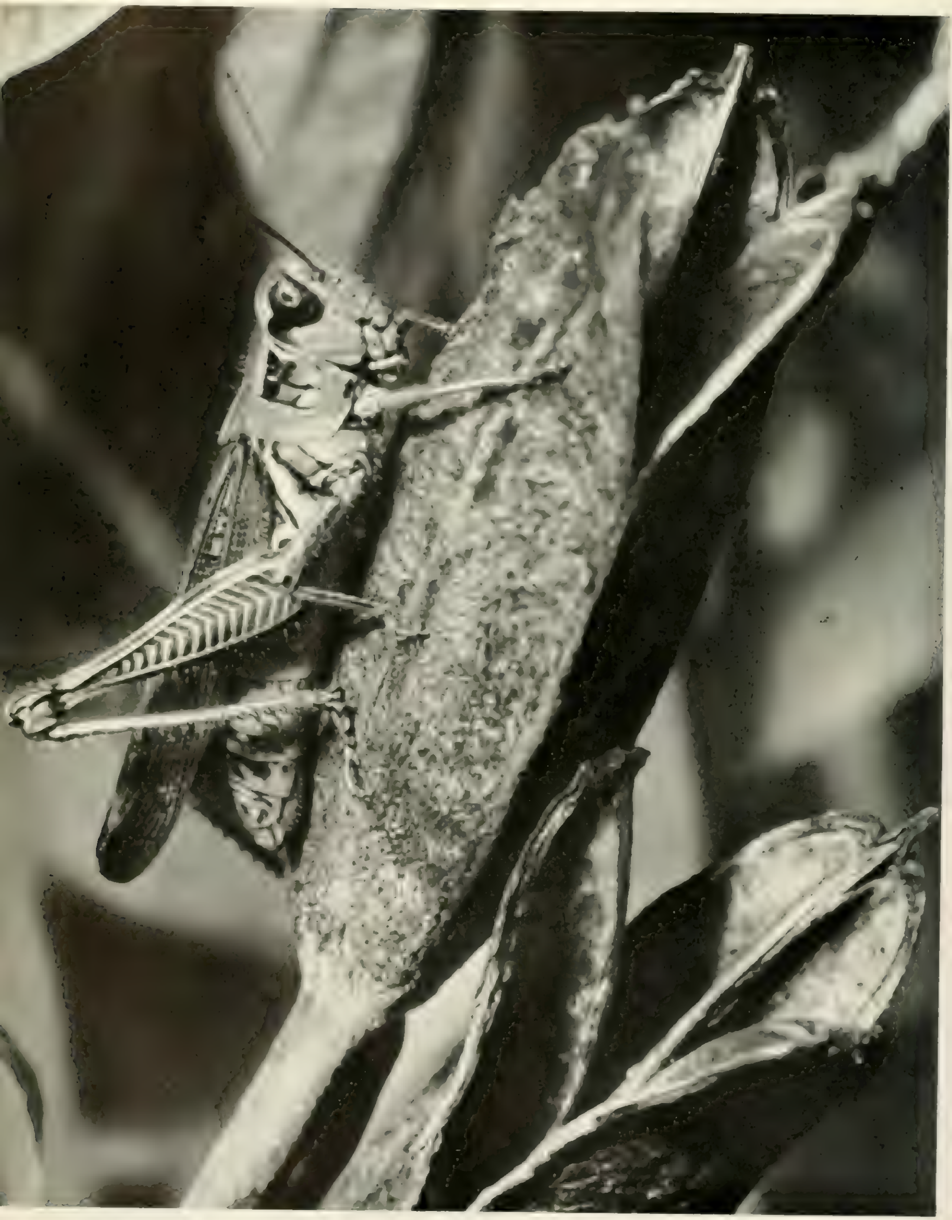
The plain across which it flowed was the same plain under which were buried the craters and the fragmented rocks of the volcanic eruptions described in last month's NATURAL HISTORY in the story of Shiprock. And the uplift which produced the San Juan canyon was the same uplift which finally resulted in the exposure of those monuments.

This uplift was very slow and occurred only along the lower half of the river. There the river cut its bed deeper into the land as the banks rose about it. Soon the channel was so entrenched that the stream was no longer able to shift its course under the pressure of the floods and freshets. The crooked course which it had developed during its free and untrammeled days was now indelibly impressed upon it. In the region of the Goosenecks it now had to travel 23 miles to gain an actual air-line distance of seven miles. In the Great Bend it now had to travel eight and one-half miles to gain one! And from the place where it entered the canyons, near McComb Ridge, to the place where it entered the Colorado River, it had to travel 135 miles to gain 63. Its journey was just twice as long as if it had set a direct course and never wandered from the straight and narrow.

And still the uplift continued; the soft sediments which surfaced the plain were worn through, and the river came upon the harder rocks underlying the plain. These rocks were folded into broad swells and valleys which crossed the river course at right angles. Ordinarily, such folds of harder rock are able to alter the course of a river, but not so with the San Juan. It was fixed upon its course. It could only continue in the channel which it had already cut so deeply, a channel which led it across the valleys and over the ridges. And so today, the San Juan River is noteworthy not only as one of the most crooked streams in the world and one that has entrenched its spectacularly deep snake-like meanders; it also is a stream which has subsequently disobeyed the usual rules imposed on rivers by the structure of the underlying rocks in their paths. It is an impressive wonder of our scenic Southwest.

SEEING NATUR

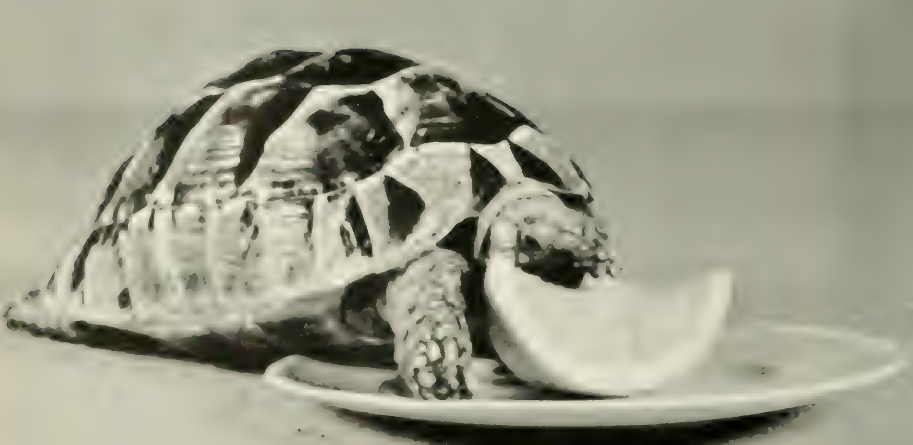
G is for Grasshopper



hrough the CAMERA'S EYE

By HENRY B. KANE

Peepers announce the spring with their chorus



ORANGE for breakfast. Cleo has a Rastus-like capacity for watermelon, her favorite repast

OUR CLEOPATRA
An Egyptian Tortoise

By LILIAN RIVERS WEIDLICH

PHOTOGRAPHS BY EDWIN C. WEIDLICH

A "LITTLE souvenir from Egypt" was given to my husband and me three years ago. The tortoise from Alexandria immediately won our hearts, and we determined [illegible] to make her enjoy life as a domestic pet in the United States.

Her name, Cleopatra, was inspired when Mr. Charles M. Bogert, Herpetologist at the American Museum of Natural History, determined that our unusual pet belonged to the only species of tortoise found in Egypt, *Testudo leithii.* She is an adult female with an uncertain past.

We have written to natural history museums and zoos throughout the country, and to date we have found no other specimen in the United States. Apparently Cleopatra thrives on our western civilization, for her weight has increased from twelve ounces in 1939 to eighteen ounces today, which is considerably heavier than the largest specimen mentioned in Major Stanley Smyth Flower's "Notes on the Recent Reptiles and Amphibians of Egypt . . .",* which contains the most complete and recent information on the animal.

Cleopatra's back shell, or carapace, measures eight and one-quarter inches long and seven and one-half inches wide. The shell is pale yellow, with lemon and yellow-green lights and shades, and a definite series of brown or reddish-black markings. The undershell is yellow, with a red-brown to black marking. Her eyes are very noticeable, like bright black buttons, and her exposed parts are yellow.

Not having any scientific information regarding feeding habits, we had to take up that matter with Cleopatra herself. During her Atlantic crossing, she tried a little of everything offered to her from eggs and toast to salad, omitting meat and showing a definite preference for lettuce and fruit. Since we have had her in the States, we feed her a large variety of fruit and vegetables. Her favorite dish seems to be watermelon, but cucumber and radish leaves run a close second. We keep a small container of water for her, which she seldom drinks, except when her face is sticky (after trying a little marmalade, for example). When immersed in water, she drinks some.

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* [illegible]

However, as the following record will show, Cleopatra has cultivated habits and received attentions in New Rochelle, New York, not ordinarily enjoyed by her species. She was given a little red house all her own, and it did not take her long to realize that it belonged to her. For several days we continuously picked her up and put her into the house. She was never disturbed there, and before long she began going into the little house to sleep, coming out only for exercise and food.

Another step in her domestication was housebreaking. When food is brought in sight, she releases what is stored in her "reservoir." Upon discovering this, we began to place her dinner plate on top of a newspaper. The system worked perfectly—except that she has apparently become conditioned to the presence of a newspaper, and we have learned through experience never to leave any newspapers lying about the floor.

Cleopatra likes warm weather but finds sitting under a radiator about as much fun as a sun bath. When it is cold, she sleeps in a warm bath towel and does not come out to eat in the morning until the house is quite warm. Sometimes in extremely damp weather, she sleeps for a few days at a time, but she makes up for it by eating more than ever when she does emerge. In summer, she likes to dig in the back yard, but in winter she just plays in her sand pile. She likes to sit in warm water, but shows no interest in swimming.

Cleopatra is no example of the proverbial tortoise's slowness, for she is extremely active. She rushes to my husband or to me when we call her, by means of taps on the floor. As a reward, she expects to be fed or at least to be tickled under the chin. She usually starts her day by coming out of her house to climb over my husband's feet as he is shaving. She climbs over and under furniture and has become quite an acrobat. She likes to climb over and over the hurdle Eddie has made for her or, better still, she likes to receive his undivided attention and do acrobatics on his hands. She

ON TIPTOES for grapes. Cleo thrives on our western diet and proves it by sporting the record weight for her species

ADMIRING CHILDREN are Cleopatra's most enthusiastic friends

[illegible] For example, when we first [illegible] at New York City, Cleopatra spent hours trying to climb up the three-inch step to the bathroom. When she finally succeeded, it became her favorite sport.

Cleopatra dislikes heights. A table or a chair, from which she cannot descend, is a prison for her. She paces continuously back and forth, looking apparently puzzled at the situation until no possible method of escape has been overlooked. But she takes no real risks and has never fallen. If there are no means of escape, she finally gives up and goes to sleep.

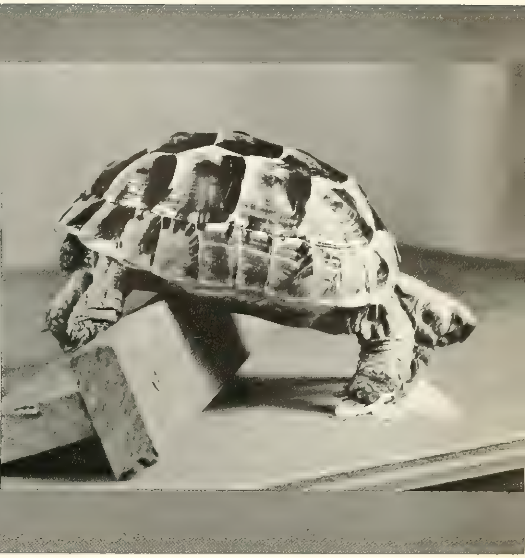
Cleopatra has become so very tame that we fear she would not last long now in Egypt along the Nile. She has practically forgotten how to pull herself into her shell. She sleeps with her head out and seems to be too curious, even among strangers, to keep it in more than a few seconds at a time.

She is an interesting pet, and we are even looking forward to the time when we can get her a mate from Egypt.

WITH the patience of Job, Cleopatra masters the hurdle

FREDDIE is Cleopatra's "protector." Trusting curiosity has won her many friends

THE PROVERBIAL HARE would be surprised at her agility



CLEO co-operates best if a tempting morsel is her reward

STICKING HER NECK OUT is safe in her new home. She has almost forgotten how to duck

STRATEGIC MINERALS

NUMBER V

MICA

Mica, mica everywhere, on our earth and in our earth, but the large crystals whose unique properties are so essential in wartime are scarce and costly to process

By FREDERICK H. POUGH

[illegible]

THE entire earth's crust—in many places from the dirt mantle down, and elsewhere below a superficial layer of sediments—is composed of igneous rocks, such as granite, diorite, gabbro, and peridotite. A high proportion of granite and diorite, and an appreciable amount of the gabbro and the peridotite, is mica. Yet mica, the dominant constituent of many metamorphic rocks and a prominent constituent of the igneous rocks, is on our list of strategic materials—materials of which our domestic supply is insufficient for our needs.

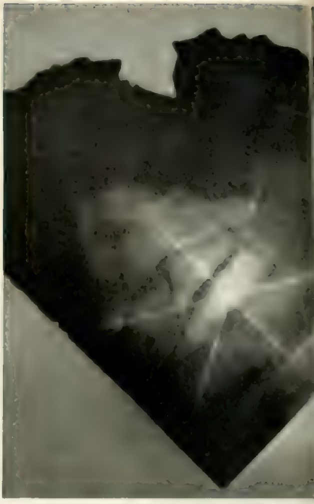
One might suppose that mica was one of the last things to think about in our war industries. Probably few people appreciate the part that this common mineral, with its unusual properties, plays in our daily lives. As one small use: 250 million small mica plates went into our automobiles annually. Did you have toast this morning? Mica served an important purpose in your electric toaster. Were your clothes pressed? Without mica the electric iron would not be so small and handy. Did a plane fly over? Without mica the plane would not be so safe. Did you ride in an elevator? The elevator ride, while possible, would have meant much more trouble [illegible]

So it goes with mica, and our lives have been built on the belief that mica would always be available. Substitutes would work, different motor and generator designs could be developed,—but they haven't been, and now we should find it difficult to get along without it. Right now we must view the situation with the greatest concern, for almost all of the world's fine quality mica comes from India.

Mica is a general term; it includes a number of minerals, some of which are useful and some of which are not. Though mica is used in a number of ways and in different conditions, all of the uses are dependent upon its unique physical properties. The micas are a mineral family; they are hydrous silicates of potash and alumina; magnesia and alumina; magnesia, iron and alumina; or lithia and alumina. There are a host of others, and one mica may grade into another, but these are the commonest and they are called muscovite, phlogopite, biotite, and lepidolite. In color they may vary from white through brown to black and lavender. Some of the properties, like the color, differ according to the composition, but all types of mica possess several things in common, the most obvious of which is a pronounced basal cleavage.

Cleavage is the tendency of a substance to break in definite planes, leaving a smooth fracture surface. Some minerals cleave with ease, some with difficulty; some have cleavage in several directions, some have it in but one. The micas have a single pronounced cleavage which is parallel to the base of the original crystal.

This alone, however, does not explain the unique desirability of mica. Topaz too, has a fine basal cleavage. But if you could get such thin plates of topaz, they would not have the toughness and the elasticity of the mica flakes. Some of the best quality of mica, known as "cigarette mica," can be rolled into a tube surrounding a rod one-eighth inch in diameter, without breaking, crumbling, or having its surface impaired in any way.



Mineral collectors take pleasure in findin phlogopite sheets showing a star—like th star in a sapphire. These stars are caused b innumerable microscopic parallel inclusion

Many other things can be thus bent, it is true, even this paper. But can you think of another that can then be heated to above 1000 degrees and remain a good insulator while a 12,000 volt electric current passes through the rod? That is what mica must do, and does. At the same time it is tough, it cannot break under normal conditions, it resists water and acids, and is transparent, even in fairly thick sheets. All of these remarkable properties make it valuable in industry. The ease with which it can be split and its resistance to electricity indicate its field of usefulness; its strength, flexibility, resistance to heat, and softness determine the applications.

Though mica is an important constituent of many rocks it is not the kind of mica that is strategic, and little "rock-making" mica is used commercially. The mica which we need, the mica whose supply is now so critical, comes in larger crystals than those we see sparkling in the granite and the schists. As a last stage in the crystallization of a mass of granite there are often many small sheet-like intrusions which crystallize with much larger crystals than those of the granite rocks of the main mass. These are known as pegmatites, and in them we find rare

(Left) Only clear, transparent sheets of mica provide the punched-out forms vital in electrical equipment. Mica containing iron oxide *(background)* is valueless for such use

minerals which were not present in any of the rock from the parent magma, along with the common quartz, feldspar, and mica. Many of our gems owe their birth to these pegmatite dikes; tourmalines, aquamarines, and topaz are found in such deposits. And the mining of mica is much like the pursuit of these rarer gems, except that when mica is mined it is desired for its larger crystals, not because it cannot be found elsewhere. Whereas crystals in the rock may be millimeters across, the crystals in the pegmatites are measured in centimeters or even meters.

The micas which are widely used and which are considered critical are two: muscovite and phlogopite. Muscovite is a potash aluminum silicate, and its name is derived from the original source, Russia, whence it was brought to England for use in stove fronts. It no longer comes from Russia, but its use in stove fronts and in peepholes in blast furnaces still accounts for an important percentage of the finest and most transparent cleavages. Its unfusibility and its stability under heat makes it the only material which can be so used. Phlogopite, the magnesium equivalent of muscovite, is even more resistant to heat but less transparent; its name is derived from a Greek word meaning flame-colored. Muscovite is usually light in color and ranges to a red-brown, the latter shade often being known as ruby-mica. Phlogopite is usually darker brown and is commonly spoken of as amber mica, to distinguish it from the muscovite.

Each has its special uses, though if the emergency required, Canadian phlogopite could undoubtedly be substituted for many of the things in which Indian muscovite is now used exclusively. Both minerals crystallize in the monoclinic system, but their crystals look hexagonal in outline. Phlogopite is relatively soft, about the same as copper, and because of this, it is easily split into its cleavages. Because of the molecular cohesion in the basal plane, amazingly thin layers can be split off. A common thickness widely used is about one-thousandth of an inch. Sheets no thicker than this can be obtained in almost any size the crystal will permit, perhaps 80 square inches in area or even more. Normally, of course, they are much smaller. The splittings are very tough and flexible, they may be rolled and bent with no sign of rupture, and through it all they retain their resistance to the passage of an electric current. Being so soft they are easily cut; and the shapes desired are commonly punched out by steel dies. One or more shapes may be cut from each piece of clear mica, as we see in our illustration.

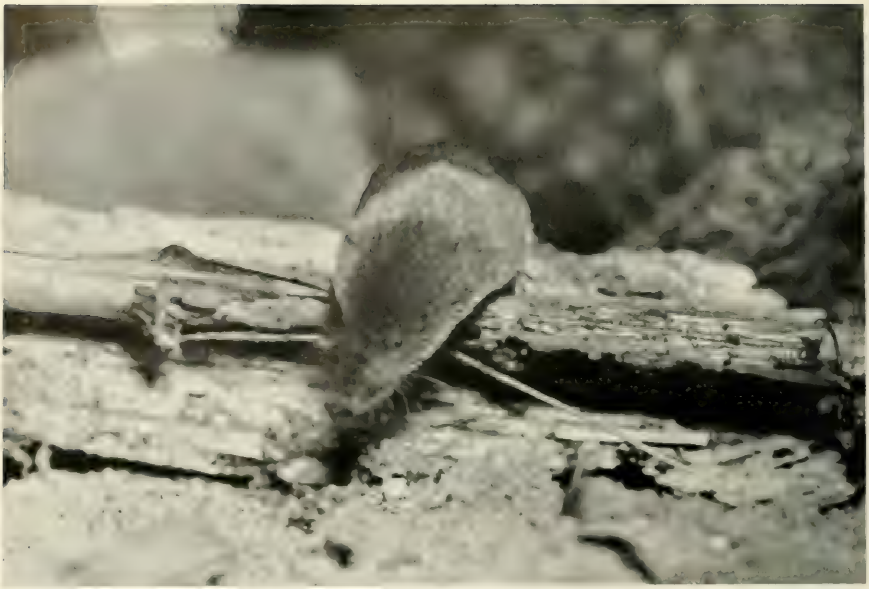
The American shortage of mica is as much an economic problem as geologic, for mica requires considerable preparation for use. This handwork is expensive and requires a certain amount of skill. The skill and the cheap labor supply has been developed in India for many years, with the result that today that country dominates the world market. The mica is mined in more or less regular crystals, which are embedded in quartz or feldspar. These are "cobbed" to clean off the attached rock, and then they are "rifted" into sheets thin enough to be cut with a blade. The sheets are trimmed to remove the tattered edges and impure portions, and then are graded according to size and quality.

The best quality is clear and flawless. Iron oxide inclusions, like those in the sheet which forms the background of our picture, make the mica valueless for electrical purposes. The sheets are then split to different thicknesses depending upon the use intended. "Blocks" are one-hundredth of an inch or more thick, "films" are nine-thousandths down to one-thousandth of an inch thick, and "splittings" are thinner than one-thousandth of an inch. The splitting is done by hand, one person doing from three to four pounds a day for the equivalent in India of three cents a pound. Machines to do this work have been tried, but without much success, and the cheap Madagascan and Indian labor have kept the need from being urgent.

Most of the electrical mica is in the form of splittings, and these thin films are built up into a mica board composed of alternate layers of overlapping mica splittings and a binder of shellac. These boards can be made to any desired size, and for many uses they are as satisfactory as single mica blocks. Molded mica products are often made from such mica boards. Usually in these the binder runs to more than the one or two per cent found in the flat sheets.

Your toaster wires are wound around a mica sheet, or probably around several mica sheets which have been fastened together with small rivets. Your electric iron is similarly equipped, though with a single sheet. But these are dispensable uses. In electric generators, electric motors, and radio tubes, mica is indispensable, to separate hot parts through which electricity is conducted and thus avoid short-circuiting and power loss. In airplane spark plugs, mica (both mus-

continued on page 289



IN SEARCH OF PLUNDER: "Nothing there." This mite of an animal sees poorly with its tiny eyes, but its other senses are excellent

(PHOTOS TWICE NATURAL SIZE)

THE TAMING OF A Shrew

By GEORGE G. GOODWIN

[illegible]

ALL PHOTOS BY THE AUTHOR

Though only an inch and a half long, the first pygmy short-tailed shrew found in New England in over a century proves to be a lively and interesting pet

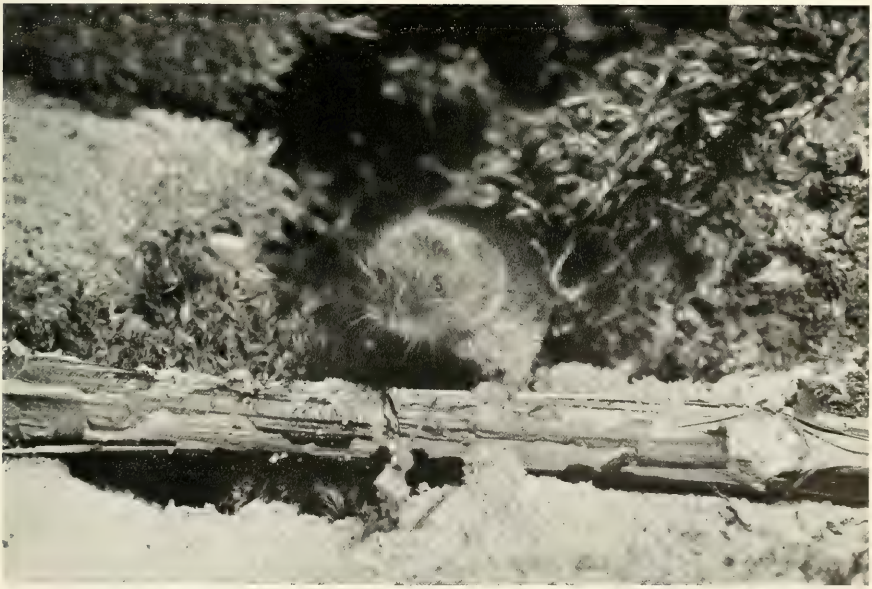
SOME years ago I read an article in which a scientist at the Smithsonian Institution turned over a rotten log in Maryland and found a pygmy long-tailed shrew—the third specimen of that rare shrew on record. Since then I have never been able to resist the temptation to look under fallen, moss-covered logs in the woods. And it is surprising what a number of interesting little creatures one finds there.

But perhaps my greatest surprise came last summer when, turning over an old log on a salt marsh at Westbrook, Connecticut, I saw a tiny furry creature, whose body was no more than one and a half inches long. It was darting along a shallow runway, making for the nearest cover.

The short tail was what caught my eye, for that is what distinguishes the rare pygmy short-tailed shrew from the commoner long-tailed species. It therefore became very important to catch this little animal and determine whether so rare a prize had been found,—an animal of which only one other specimen had ever been recorded in the whole of New England, and that one more than 100 years ago. The first specimen had been taken by Linsley in 1840, at Darien, Connecticut.

(Above) AGILE AND FEARLESS, he could kill many times his weight in garden worms—veritable giant pythons to him

(Below) WHEN he became accustomed to his new home, the least sound brought him stalking from his den



Catching these little denizens of the woods by hand requires some experience, not only to avoid hurting the little creatures but because they move with surprising speed in their own territory. To grab at them usually leaves one with only a handful of soil or leaves. When in Turkestan I learned a trick in catching the small desert mice that come out of their holes a foot or two. It is based on the principle of guessing where the animal will go when frightened. You then grab where you expect the animal to be—at the mouth of its hole if one is visible, or at the nearest natural shelter. Snap judgment is necessary, but practice brings results.

The little shrew was making for the nearest shelter so my hand automatically reached for the same spot. Fortunately we met, and I held a miniature in animal life if ever there was one, a tiny creature with a soft silky coat, minute eyes, long mobile nose, the tiniest of feet, and a short tail. There could no longer be any doubt; it was the pygmy short-tailed shrew, named by the celebrated American scientist, Thomas Say, *Cryptotis parva*. It weighed three and three-quarter grams, or less than one-seventh of an ounce, though it was fully adult.

Shrews rarely live long in captivity; few indeed survive more than a few hours when taken from their natural surroundings. I had little hope that mine would be any exception, but he sustained the journey back to the city in a box with a layer of moss and an ample supply of insect life for food. A real domicile was provided for him, with all the comforts of his woodland home—mossy bank, sandy area, the coveted rotten log, and a swimming pool. This was explored from end to end; then he secreted himself underground. For two weeks we had nothing more than fleeting glimpses of him, as he scurried for [illegible] around. Gradually he associated my presence with food which he would grab tenaciously and drag away to devour under cover. In his tiny mouth he would unhesitatingly [illegible] garden worms, to him like a giant python, and skillfully avoid its writhing coils. Sometimes the worm would succeed in getting its tail anchored in the soil and there would be a violent tug-of-war. The worm, being stronger, usually won the first round. Nothing daunted, this resourceful little creature immediately dived underground and presently the monster went "into reverse" with the shrew on its tail, and the battle was soon over.

As time went on he became more bold and at the sound of my footsteps was out nervously pacing back and forth waiting for his supper. Never for a moment did he remain still. If nothing else, his mobile snout was twitching around in all directions. A camera with shutter set at 1/200th of a second failed to stop his actions. Like all shrews, he could not see very well, and I am convinced he could not recognize his food held two inches away. But once it touched the ground, he was there like a flash. He had a good sense of smell, while his hearing and sense of touch were really acute.

He learned to eat out of my hand and even crawled over my palm to pull at his food, with his tiny feet pressed tightly on my fingers. When once he got the food free, he would scamper off to store it away, and

"SOMETHING UP THERE?" his nose asks. He proved that even an animal weighing only 1/7 of an ounce can have personality

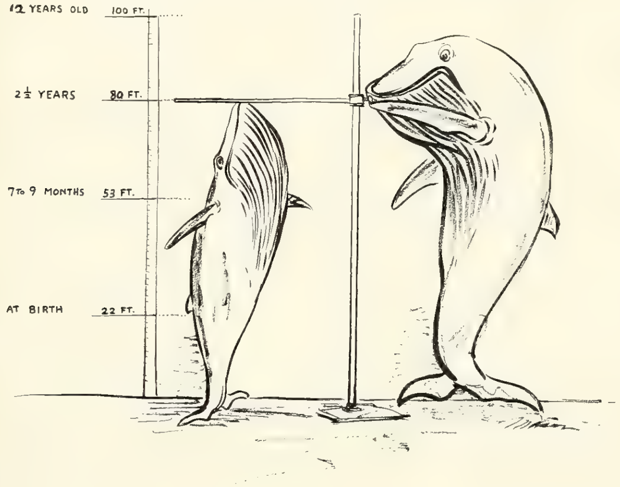
RETREAT. Note characteristic short tail *(below.)*

was then back for more. I fed him once a day but gave him more than he could eat at one meal. Raw beef, liver, chicken, meal, and garden worms made up his daily diet, and for a special treat he got amphipods that I found under driftwood along the beaches. Of these he was very fond.

He was a ferocious little creature for all his size. He worked laboriously over a whole can of worms, dragging them out one at a time and villainously murdering each one, until the whole can was empty. Then he made another trip to be sure he had missed none. I found the whole collection underground in one spot, more than he could possibly eat in several days.

He lived four months in my care and showed considerable courage and daring. We had not hoped we could keep him as long as this; but the loss of this diminutive creature was something of a tragedy all the same. He contributed more than his share of pleasure and in addition contributed to our understanding of his kind, so that his life in its end has been preserved for the enlightenment of science.

THE LARGEST ANIMAL


12 YEARS OLD
100 FT.
2½ YEARS
80 FT.
7 TO 9 MONTHS
53 FT.
AT BIRTH
22 FT.

By JOHN ERIC HILL

Drawn by
G. FREDERICK MASON

THE blue whale, sometimes called the sulphur-bottom, is not only the largest mammal but it reaches the largest size of any known animal, living or extinct. Until recently it was thought that an animal of such great size would need a long time to grow up. The largest land animal, the elephant, does not reach adult size until about 25 years old, and the elephant is a pygmy compared with the great whale.

A few years ago, scientists were sent out to the whaling stations and on ships to learn all they could about whales. Hundreds of whales were measured and examined, and the facts discovered were surprising.

The largest unborn whales reach 22 feet in length, and the youngest baby whales accompanying their mothers were about that length. Thus the blue whale was shown to be larger at birth than any land mammal. The examination of some 50 unborn whales showed that a whale embryo only a foot and a half in length was shaped almost like the adult and that growth in the latter part of its life before birth is rapid. The total period before birth is only about eleven months.

After the calf is born, it more than doubles its size in approximately the first seven months. As long as it is dependent on its mother for milk, the whalebone-sieve in its mouth remains small, but once the youngster begins to feed itself this sieve is needed to catch its food. Whales about 53 feet long are the smallest that have usable whalebone, and calves still suckling are only a little smaller than that.

The young whale, now beyond infancy and beginning childhood, does not grow so rapidly. But by the time it reaches adolescence and the time of potential parenthood, it is about 80 feet long. This is at about two and a half years of age. Males are a little smaller than females.

How old do the great whales get to be? No one can say exactly, but the ovaries of the cow whale retain a record of each breeding season through which she has passed, for a scar is left each time an egg-cell breaks out of the ovary. By counting these scars it is possible to judge approximately the age of a whale. The oldest known blue whale was about twelve years old, as determined this way, and the maturity of her skeleton showed she could not grow much more. The longest whale for which accurate measurements are known was about 100 feet.

Thus, after years of guessing, application of scientific methods has resulted in a relatively clear picture of the growth and development of the greatest mammal.

HIDDEN VALLEY

By JOHN H. DEPUY

A HIDDEN valley [illegible] to climb.

[illegible] ton Sea, a lake without an outlet. By auto- [illegible] nine Palms, the nearest town.

[illegible] landscape in which juniper, sagebrush [illegible] principal vegetation. There are many liz- [illegible] possibly even wildcats in the valley and [illegible]

Indians are said never to enter the valley, owing to the strange shape of rocks there.

Hidden Valley [illegible] few people but has recently been dedicated [illegible] the traveler.

(Left) Since the rocks surrounding the valley are almost impossible to climb over, the only way in is through this tunnel in the rocks

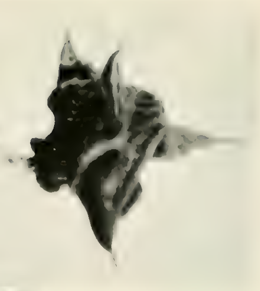
(Right) A view inside Hidden Valley

(Below) The astonishing formation known as Trojan Rock, from a distance

Trojan Rock, carved by natural forces in remarkable likeness of a human head, is 40 or 50 feet high

(Below) Bull Rock, another natural rock formation, is perched upon a rock pile some 300 feet high

Beware of the CALTROP



WHY is this object called a caltrop?

(Left) DO NOT TRANSPLANT the caltrop, or water chestnut

[illegible]

By B[illegible] BROWN

THE [illegible] caltrop, however, is not an impediment to [illegible] in the Potomac River. Native only to Eu- [illegible] it spreads rapidly and soon impedes navi- [illegible] bottom by cord-like stems, sometimes four- [illegible] In water less than eight feet deep motorboats, [illegible] impossible to pass. The seeds have long, sharp, curved spines that make painful sores.

When in 1933 the caltrop formed exten- [illegible] lem of eliminating this undesirable plant [illegible] Wildlife Service. A few years later, when the pest restricted river traffic to a narrow channel, United States Army engineers forgot the old byword "All's well on the Potomac" and joined the Service in [illegible] problem.

[illegible] machines were used with varying results. Hand labor has been successful in controlling the water chestnut, as the plant is otherwise known, but is expensive and tedious. The transplanting of this plant is strongly discouraged, as it wipes out other plants valuable to waterfowl and discourages fish. "Do not spread it," Wildlife officials implore visitors who are attracted by the luxuriant foliage of the plant in June. "We are bending every effort to wipe out the pest."

New York State authorities are taking measures to prevent the caltrop from spreading down the Mohawk and Hudson rivers in the vicinity of their junctions. In the Massachusetts area, the plant is [illegible]

THE CALTROP spreads rapidly, impeding navigation and discouraging fish and waterfowl

continued from page 281

covite and Canadian phlogopite) is used in place of the porcelain of your auto's plugs, because the airplane motor is operated at higher temperatures, high compressions, and with greater and more sudden temperature changes, and only mica will stand the strain.

There are innumerable other uses for this essential highly critical mineral, for example, Christmas tree snow, a powder to prevent sticking, and so on; but these are not the uses which place it on the critical list. Rather, it is the electrical and the airplane uses which make it so essential now.

American prospects are not good. In the last war little increased production took place. Then our foreign source was never threatened, but today we probably shall have to develop many more sources, and many old pits will be reopened. Mica mining is a small operation, with perhaps one man working in his spare time, perhaps several; but the nature of the deposits and the irregular yields make it a precarious venture. Best results are obtained when salable quantities of feldspar and beryl are also recovered, and often the sales of scrap mica for crushing will carry the cost of mining the better quality material. Prospects are very poor, and costs will unquestionably be far higher if we are forced to resort entirely to Western Hemisphere deposits. Domestic consumers furthermore will require a little education to overcome what appears from U. S. Bureau of Mines tests to be an unwarranted prejudice against American mica.

Canada, the United States, and South America will unquestionably increase their production this year, and some of the nonessential mica uses may be eliminated. Lower grade micas may be substituted in places where formerly only the best was used, often, probably, without any reduction in quality. Lastly, there is some hope for the development of a mica substitute from inorganic material, but there are still some kinks to be ironed out before that is done. Meanwhile, we must hoard our mica, use it wisely, develop our own deposits, educate our consumers, and expect to pay more for the mica we use. Remember that the cost of the mica has never been a very high percentage of the cost of our electrical products. After all, a $200 motor only has 40 to 50 cents' worth of mica in it.

YOUR SEARCH IS OVER!
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DO NOT MISS

Next month NATURAL HISTORY will publish the eighth and last installment in its panoramic series on animal history in North America. Under the title **ICE AGE WINTER RESORT**, Dr. Edwin H. Colbert will tell how the descent of the Great Glacier forced animal life constantly southward until Florida became a sunny refuge for such awesome tourists as the mastodon, the mammoth, and the saber-toothed tiger.

Unlike most owls, it is a bird of the day as well as the night, thus affording naturalists an unusual opportunity to study its family life. The bird is **THE SHORT-EARED OWL**, and G. K. Yeates has visited its haunts to pen what is both a well-observed portrait and a keenly-felt appreciation.

There can be no vaster view in all our panoramic land than the one from atop **MOUNT SAN JACINTO**. The account Tom Hughes gives of this sheerest of the nation's precipices should fire the mountain lover's heart with ecstasy.

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"May a freend ne'er be mair than a caber-throw away!"*

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URGENT

The Museum Library is in need of back issues of NATURAL HISTORY, particularly the first four issues for 1942. Copies sent to the Librarian, The American Museum of Natural History, New York, will be greatly appreciated.

DO NOT MISS

1 **THE TALKING DRUM FROM MANGBETU LAND.** Dr. James P. Chapin, veteran Congo ornithologist, will recount an [illegible] series of adventures he had while [illegible] the Museum's prized possessions from the Dark Continent. Dr. A. I. Good, who has resided for many years in West Africa, will explain for the first time in any popular magazine the system whereby the natives communicate by means of the drum.

[illegible] that there are over 55 species of wild orchid in the state of Vermont. Hon. Carl [illegible] Ransom, established his **WILD ORCHID SANCTUARY**, setting an excellent example for all interested in preserving America's floral wealth from the ravaging inroads of the peat moss traffic, the nerve medicine business, and sundry other commercial encroachments.

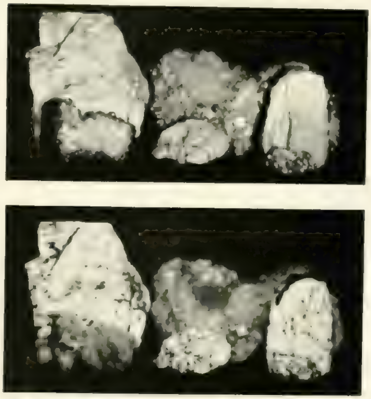
Picturing Minerals that shine in the dark

By CHARLES H. COLES

[illegible]

THE glowing face of your alarm watch, the light from the newest [illegible] lamp in your kitchen, the feeble glow of [illegible] are various forms of a phenomenon known as luminescence—"cold light" in the sense that it has little heat. The peculiar [illegible] of these types of light make for interesting photographic possibilities, if you are looking for something out of the ordinary on which to train your camera.

Three general types of luminescence are commonly recognized. *Chemiluminescence* usually depends upon the oxidation and reduction of chemical compounds. *Phosphorescence* is visible light which is given off by a compound after the light which stimulated it has been extinguished. *Fluorescence* is visible light given off by a compound when invisible light of short wave length strikes it. It is this latter type of luminescence which has been found so useful in photographic analysis of documents and experiments with minerals.



FLUORESCENT MINERALS UNDER ARTIFICIAL LIGHT

AND

UNDER ULTRA-VIOLET LIGHT

[illegible]

The fluorescent effect is most interesting when no appreciable visible light is mixed with the invisible light impinging on the luminescent material. Then the activated substance appears to glow mysteriously as if it were generating its own light. Ultra-violet light, X-rays, and the radiation from radium, though of themselves invisible, are all capable of producing visible emanations in certain substances. This emitted light, known as fluorescence, may be of almost any color, depending upon the composition of the material irradiated.

X-rays and radium radiations are so dangerous that it is wise for the inexperienced to avoid their use for experimental purposes. Ultra-violet radiation can also be harmful, but with reasonable care it is quite safe.

The cheapest source of ultra-violet light, and one that is altogether harmless, is a [illegible] glow lamp which can be purchased at a small price from scientific supply houses and dealers in minerals. This bulb is merely screwed into a regular lamp socket on the house current. A dim violet glow can be seen around the electrodes in the bulb. This glow generates a small and thoroughly safe amount of ultra-violet light, which penetrates the glass bulb and is used to irradiate fluorescent substances.

A stronger source of ultra-violet light is the so-called "black bulb," which can be purchased for about $1.25. This is essentially an incandescent bulb but its glass is of such a deep purple that very little visible light escapes.

Quartz-enclosed mercury vapor lamps used with deep purple filters are a very strong source of ultra-violet and must be used with care. Severe sunburn and painful conjunctivitis may easily be contracted if the mercury arc is used carelessly. However, it is such an excellent source of strong ultra-violet radiation for scientific purposes that it is much used for investigating fluorescence.

An electric discharge from a spark coil passed between iron points in air produces a wide range of frequencies in the ultra-violet; but the added danger of the high voltage, as well as the noise of the sparks and the radio interference caused, keeps this arrangement restricted to scientific laboratories.

When the source of ultra-violet light is in operation, various substances may be tested for fluorescence by bringing them close to it in a darkened room. Certain minerals exhibit a strong fluorescence that is exciting to see. Willemite from New Jersey shines a bright green. Pectolite from the same state glows a faint yellow. Some fluor spar, from which the phenomenon received its name, shines an intense blue.

[illegible]

YOUR NEW BOOKS

PHOTOGRAPHIC CHRONICLE OF THE PUEBLOS • MYTHS ABOUT THE STARS
DR. BEEBE'S LATEST BOOK • INDIANS OF SOUTH AMERICA

INDIANS OF SOUTH AMERICA

- - - - - - - - - - - by Paul Radin

Doubleday, Doran, $4.00

THE third book in the American Museum of Natural History Science Series, issued by Doubleday, Doran, is a timely volume on the Indians of South America by Paul Radin. The emphasis is upon the less civilized tribes whose descendants are scattered over approximately nine-tenths of the continent. The author's method is descriptive, beginning with historic accounts of typical tribal groups.

To give the book unity and continuity the author sets up a theoretical scheme of historical interpretation based upon comparisons and contrasts with North American tribal cultures. The reader may find some of these interpretations startling and bold, but the author warns him that they are far from proved. For example, Peru is credited with taking the first step toward civilization by raising cotton and maize, and passing these elements of higher culture on to Central America where they reached their zenith at the hands of the Maya about 1100 A.D. The author's theory is that maize and agriculture came to the wild tribes east of the Andes from the United States via the West Indies, not before 1100 A.D. He is not even sure that many parts of the low countries in South America were inhabited before the Christian era.

The reader may well reserve judgment as to the dates offered by the author, but his theories do serve to give continuity to the text. The layman may find the reading heavy going but he will retain a new impression of what it is that makes Latin America so different. The time may come when "Indian America" will be the preferred term for all the countries south of the United States. CLARK WISSLER.

THE PUEBLOS: A Camera Chronicle

- - - - - - - - - - by Laura Gilpin

Hastings House, $3.00

AS indicated by the subtitle, this is primarily a book of photographs of the pueblos and cliff dwellings of the Southwest, and they were made by one of America's leading outdoor photographers. Every photograph is a picture proclaiming Miss Gilpin the artist that she is. In short the illustrations are superb, and one is reminded of the fact that a good photograph often expresses more than pages of printed text.

But in this book we have both, although the pictures predominate as they should. "Many pictures and very little text" seems to have been the slogan. The locality of each photograph is indicated in a brief discussion beneath it or on the opposite page. These discussions may be looked upon as extended captions, but they are much more. Carefully written, they contain a great deal of pertinent anthropological and human-interest material that enhances one's interest in the photographs. The author has gone to great length to make sure that the statements are accurate and dependable, and in her preface thanks those scientists who have aided her.

The dating of the subjects treated, by means of Doctor Douglass' tree-ring chronology, adds to the interest, and Miss Gilpin explains very simply and clearly the achievement of Doctor Douglass in counting time back through the centuries by means of his "talking pines."

Here we have beautiful and unusual photographs of the cliff dwellings of Mesa Verde; the ruins at Aztec (unfortunate name), New Mexico; Pueblo Bonito in Chaco Canyon; Keet Seel in Navaho National Monument; the famous White House of Canyon de Chelly; Shiprock; Rito de los Frijoles; Acoma, the "Sky City"; San Ildefonso, the home of Julian and Marie Martinez, the famous pottery makers; Santa Clara Pueblo, also famous for its pottery; the five-story apartment houses of Taos; and many others. We have presented here in small space much of the life and folklore of our Southwest by one who is genuinely interested in the Indians as people. CLYDE FISHER.

BOOK OF BAYS

- - - - - - - - - - by William Beebe

Harcourt, Brace, $3.50

TO the graceful yacht *Zaca*, bearing the 38th expedition of Doctor Beebe's Department of Tropical Research, the western coast of Mexico and Central America offered 40 or more bays with opportunities for zoological observation and collecting. Templeton Crocker, patron and gracious host, furnished every facility for work; and the cruise lasted five months in 1937-38, extending from Guadalupe Island off Lower California to the Gulf of Panama and Gorgona Island.

The more serious technical results, we are told, have been appearing in strictly scientific publications; and we have here only "the froth of the trip." As might be expected, it is full of flavor. With unending curiosity, Doctor Beebe serves up a vast array of animals, from minute phosphorescent crustaceans and the tiniest baby sailfish up to sea elephants and whales. Vegetation along the coast, ranging from desert scrub to heavy rain forest, garnishes the feast.

At times we are taken ashore to towns such as Manzanillo and Acapulco, or farther inland to the capitals of Salvador and Costa Rica. Wild creatures and scenery along the way are contrasted with human behavior, and the author's enthusiasm reaches into dance hall, circus, and natural history museums. He is equally delighted with a tide pool by flashlight, a fiesta in Manzanillo, the dancing courtship of fiddler crabs, and the wedlock of angler fishes.

This could be a guide for tourists tempted to follow the same route, but will more often serve as an armchair cruise into realms still mysterious even to a trained zoologist. Keep an encyclopedia handy, to avoid stumbling over the brotulids and oikopleura. Otherwise you must jump to the next paragraph and new thrills. Limpets you should know, and they can furnish a firm foothold. As a former "Zacasian" I take a special joy in Will Beebe's latest book. JAMES P. CHAPIN.

THE STARS IN MYTH AND FACT

- - - - - - - - - by Oral E. Scott

Caxton, $3.00

THE Stars in Myth and Fact is a book written by a man for whom astronomy is an intensely interesting hobby, a hobby followed for 20 years. Mr. Scott presents the cream of the myths based on the constellation figures and combines in each chapter mythological conceptions of the ancients with modern-day astronomical figures.

One of the most interesting aspects of the book is the discriminating choice of poetic excerpts regarding the stars and the constellations. Another is the popularly-presented derivation of many of the common star names. For those who find Allen's *Star Names*—which is, of course, authoritative on this subject—too erudite, Mr. Scott's book presents a less difficult and more readable volume of material.

Line-drawings and star charts abound, but in most cases these would be rather difficult for the beginner to follow, as must honestly be said of almost all charts.

Now and then in perusing the pages of this book the astronomer will stop short. There is much here that seems not to belong in an astronomical volume, even in one dealing with myths. For instance, at the end of Chapter Eleven, "Symbolism of the Bears," Mr. Scott says:

"In the Indian legend the lost hunters

[illegible]

students who are stationed in camp. They [illegible] indeed. This is natural enough. As long as they are stationed in our regular camps, however, a certain amount of time is available for recreation and reading for [illegible] extent your magazine is finding its way into the reading rooms of the military camps. It appears to me to be ideally suited for the casual reading of young men interested in natural history in all its aspects.

I am interested in this matter not only [illegible] the New York Academy of Sciences, but also as Chairman of the Division of Geology and Geography of the National Research Council. I hope sincerely that you will find it possible to secure the funds to distribute NATURAL HISTORY to all the military camps in this country. It would seem possible that government funds could be made available for that purpose or perhaps some of your members might be induced to subscribe to the Magazine on behalf of specific camps.

If there is any way in which I can be of assistance in this matter I shall be glad to do so.

[illegible]

National Research Council,
Washington, D. C.

• • •

[illegible] vices may maintain an interest in the [illegible] servation and an appreciation of the [illegible] NATURAL HISTORY Magazine urges readers to heed this suggestion. A three-dollar check, which does not even pay the cost of producing the Magazine, will enable the American Museum to send NATURAL HISTORY to any man in the service for one year. Designate to whom you would like to have the Magazine addressed, or let us select a camp library where [illegible]

• • •

[illegible]

. . . Mr. Grant certainly deserves much praise for his ruffed grouse photograph [illegible] such a shot . . .

[illegible]

Rehoboth, Mass.

[illegible] safely home by the little child, who proclaimed herself the spirit of the Pole Star. Hebrew literature suggests a similar idea —'A little child shall lead them.' Jesus likewise taught 'Whosoever shall not receive the Kingdom of God as a little child, shall not enter therein. . . . Only intuition grasps essential spiritual truth, which is the essence of the Kingdom within. . . ."

[illegible] who would like this kind of writing to make up a good-sized audience for Mr. Scott's book. But there are many who will feel that the good characteristics of *The* [illegible] overshadowed by the occasional religious and astrological interpolations.

The teacher of astronomy and the amateur will find herein many new and useful suggestions concerning constellation outlines and stories.

[illegible]

PICTURING MINERALS

Wernerite from Canada radiates a golden yellow. Certain calcites glow pink. Autunite fluoresces a vivid green. All of these minerals may be purchased from dealers in rock specimens.

Materials other than minerals will glow if the ultra-violet radiation is strong enough. One's teeth and fingernails glow bluish. Petroleum jelly glows white. Canary glass (glass colored with oxide of uranium) glows a vivid yellow-green. Various inks glow in different ways, pointing to a valuable method in detecting forgeries. Modern laundries mark their customer's property with fluorescent inks that are invisible until they are taken into a darkened room and flooded with ultra-violet light, whereupon the initials glow brightly.

Photographic film is very sensitive to ultra-violet radiation, and although the glass of the lens does absorb the higher ultra-violet frequencies, it still permits a large part of the lower frequencies to enter the camera. You must remember that when you are photographing the phenomenon of fluorescence you do not want your camera to record the ultra-violet but only the visible colors into which it has been transformed, otherwise the film may be fogged. The haze filter that is used for Kodachrome is really an ultra-violet absorbing filter, so this may be used over the camera lens to hold back the unwanted radiation. A still more efficient absorber of ultra-violet is the 2A filter, also used with Kodachrome on cloudy days.

Exposures will necessarily be quite long because of the dimness of the fluorescence. A tripod is a necessity. The exposures must be made in complete darkness, so that only the fluorescence will be recorded.

Kodachrome pictures may be made of fluorescent minerals with striking results. Here, again, the 2A filter must be placed over the lens to avoid an over-all bluish cast in the picture, caused by the invisible radiation. If allowed to enter the lens of the camera unimpeded, ultra-violet light would cause the glass of the lens to fluoresce blue and produce a bluish cast in the color transparency.

Using a mercury vapor lamp enclosed [illegible] that an exposure of two minutes at f:2 was successful on Kodachrome-A with a 2A filter. The exposure was arrived at by trial and error, the fluorescence being too faint to measure with an exposure meter.

If a weaker source of ultra-violet is used, such as the argon bulb mentioned earlier, much longer exposure would be necessary. It will probably be less expensive to test with black-and-white film before going full out with Kodachrome. Also you will want to take a photograph of the same subject under ordinary light for comparison with fluorescent effect, as we have done with the minerals illustrated here.

We have mentioned only a few of the applications of ultra-violet radiation, for it has a wide range of uses, not only in mineralogy* but in the detection of crime and espionage. So if you yearn for novel experiments in picture-taking try fluorescent photography. It is an unusual field, with strange and interesting possibilities, especially in color.

---

*[illegible]

[illegible]

. . . I will appreciate it if you will let me know if it is possible for you to get me a reprint of the ruffed grouse cover on the March issue. . . . It is a most remarkable and beautiful photograph. By the way, is this a natural color photograph?

[illegible]

New Brunswick, N. J.

Mr. Cleveland Grant's ruffed grouse is a natural color photograph taken with 35 mm. Kodachrome. Copies of it can be obtained from the Editorial Office of NATURAL HISTORY at 5¢ each plus 5¢ additional on [illegible]

NOTICE

Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

NATURAL HISTORY

THE MAGAZINE OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME L

June-December

1942

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NEW YORK

TO OUR READERS

YOUR magazine **NATURAL HISTORY** has been published for over forty years as a public service without profit.

Starting as a modest American Museum leaflet, it has become an important national publication.

Your encouragement and enthusiasm have made this possible

Back of **NATURAL HISTORY** is the Museum with its great explorations, vast collections, research material, and staff of renowned scientists interpreting life in its myriad forms.

NATURAL HISTORY aims to acquaint Man with the wonderful world of Nature so as to aid him in better understanding of his environment and of himself. This is also one of the Museum's great aims.

NATURAL HISTORY and the Museum are inseparably bound together—help for one means help for the other.

The war provides great opportunities for our scientists in essential war activity and for the Museum, in helping Man to understand and overcome many of the difficulties that lie ahead.

But the war unfortunately has caused heavy loss in endowment income and city financial support for the Museum and rising publication and circulation costs for **NATURAL HISTORY.**

The Museum and **NATURAL HISTORY** will carry on but are now compelled to call on you for co-operation and help.

To meet increased publication costs we have regretfully decided to raise subscriptions from three to four dollars, effective June 1st. Other magazines have also had to raise rates.

In addition to renewing your subscription we further ask you personally to secure one new subscriber. Please do this as a service for the advancement of scientific knowledge.

For the benefit of members who are willing to do more than this service and obtain many new subscribers, friends of the Museum make a generous proposal, described on the following page.

If you renew when your subscription expires and also secure for us one new subscriber, you will have done your part to help **NATURAL HISTORY,** the Museum, and the great American cause of human enlightenment.

For many years we have done our best to serve you. Will you help us in this time of need?

A. Perry Osborn

Acting President
The American Museum of Natural History

MEMBERSHIP CONTEST

Today there are 50,000 enthusiastic subscribers and readers of NATURAL HISTORY. We hope to double this subscription list.

Since we cannot afford to undertake a nation-wide advertising campaign, broadcasting the merits of NATURAL HISTORY and the privileges of Museum membership, we call upon our members and subscribers to assist in the achievement of this goal.

Canvass your neighbors, friends, and acquaintances. Introduce them to NATURAL HISTORY . . . let them glance through several of your copies . . . you will find an instantaneous reaction of interest. Typical response received at the Museum from newly enrolled members is, "Why haven't I learned about NATURAL HISTORY before . . ."

You are aiding the great American cause of human education and enlightenment.

$1,600

in U. S. War Savings Bonds (face value) has been donated by friends of the Museum to be distributed among those who obtain the greatest numbers of new NATURAL HISTORY subscribers.

Rules

1. This contest is limited to NATURAL HISTORY MAGAZINE subscribers within the confines of the United States. Employees of The American Museum of Natural History and their families, and professional magazine solicitors, are not eligible.
2. To qualify for the contest, you must send in at least five new subscriptions upon the attached subscription envelope. Each contestant so qualifying will receive a one-year renewal of NATURAL HISTORY free.
3. Payment of $4.00 must accompany each subscription.
4. Renewals will not be considered new subscriptions.
5. **The attached envelope contains five subscription forms. Additional envelopes may be procured from the Membership Secretary.**
6. **In case of ties the tying contestants will be required to submit a letter of not more than 50 words setting forth the merits of NATURAL HISTORY, and the award will be made to the contestant submitting the best letter.**
7. **THIS CONTEST CLOSES ON SATURDAY, OCTOBER 10, 1942. ALL SUBSCRIPTIONS MUST BE RECEIVED ON OR BEFORE THAT DATE OR BEAR THE POSTMARK OF OCTOBER 10TH. THE WINNERS WILL BE ANNOUNCED IN THE NOVEMBER ISSUE OF NATURAL HISTORY.**

Prizes

$500 in U. S. War Savings Bonds for the member who obtains the highest number of subscriptions.

$300 in U. S. War Savings Bonds for the member who obtains the second highest number.

$100 U. S. War Savings Bond for the member obtaining the third highest number.

$25 in U. S. War Savings Bonds for each of the twenty-eight members obtaining the next highest number of subscriptions.

Address all communications to

Membership Secretary, The American Museum of Natural History,
New York, N. Y.

LETTERS

Sirs:

. . . Incidentally, Natural History Magazine is one of the most interesting and worth-while magazines I have ever read and I should not like to be without it. I first became familiar with it through a medical friend who presented me with a year's subscription and I have taken it ever since. . . .

Norman C. Yarian, M.D.
President, Cleveland Orchid Society
Cleveland, O.

* * *

Sirs:

. . . Please send me another copy of your May issue containing that admirable account of eels and their admirers in all ages, for which payment is enclosed. The chart is especially valuable. . . . The whole article is a wonderful summary of what man knows of the eel, past, present and future. . . .

Henry G. Schneider.
New York, N. Y.

* * *

Sirs:

Having just renewed my membership for a second year, I wish to express my satisfaction with your interesting publication and my regret that I did not join the society sooner.

The articles on the dinosaurs by Doctor Brown I found particularly entertaining and hope that many others on the ancient world will follow. May I suggest that someone write on the nature of evidence accepted to establish the length of time for geological ages? Problems of the professional, such as the ancestor of the Eohippus, make the subject matter very realistic for the general reader, and I am very curious to know what serves the paleontologist for a chronometer.

Joseph P. Crockett.
Washington, D. C.

Such an article may be forthcoming.—Ed.

* * *

Sirs:

It always gives me pleasure to send in a subscription for the Natural History Magazine. I know of nothing so big for the money.

Anne A. Risley.
New York, N. Y.

* * *

Sirs:

. . . Acknowledging receipt of the first issue of the magazine Natural History. I think that I shall enjoy every moment that I spend reading this most interesting of magazines. Also received the Associate Membership card for 1942. . . .

Mrs. Annie B. Rollmann.
San Antonio, Tex.

* * *

Sirs:

The article "Feathered Fishermen of Bonaventure" by Joseph Gordon which appeared in the April issue of your magazine was most interesting. The language and pictures which Mr. Gordon used were extremely well chosen.

My classes in science found the article very enlightening.

We would like to see more articles by Mr. Gordon in future issues.

Kate R. Miller.
Baltimore, Md.

READERS are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

IMPORTANT NOTICE TO READERS

NATURAL HISTORY is not published during July and August. Those members, however, who wish to have their September issue sent to a temporary summer address are requested to notify the Membership Secretary, giving the date at which they will return to their permanent address.

Moulin photo

The avenue of the giants is now in the path of lumbering operations. Conservation begins with the citizen, and every American should share a feeling of pride in the natural beauties of the wilderness, which gave birth to so many American traditions. The Save-the-Redwoods League, a nation-wide organization established during the last World War, is an example of what a group of public-minded citizens, with the aid of their state governments, can do toward conserving Nature unspoiled.

A Message of Confidence

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ALBERT E. PARR, Director

VOLUME L—No. 1 ★ ★ ★ ★ ★ ★ **JUNE, 1942**

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MEDICINE M

THE

By Alfred Métraux

After centuries of superstition, the Mataco views a world half real, half imaginary

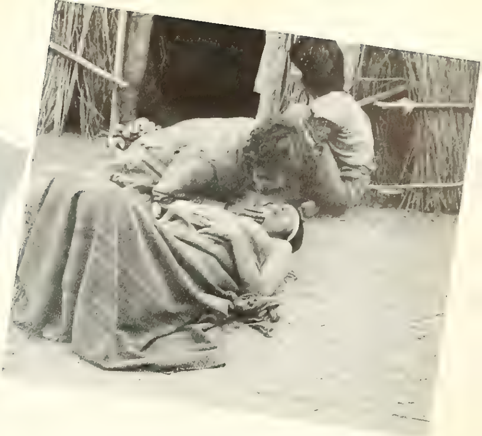
(Below) Wise in the curative arts and folklore of his tribe: a Pilaga shaman. The belt is purely ornamental

A group of Matacos with medicine men expelling disease from their midst

N OF

CHACO

The bedside manner of the native doctor is a study in basic human emotions and an impressive demonstration of the power of spiritual beliefs

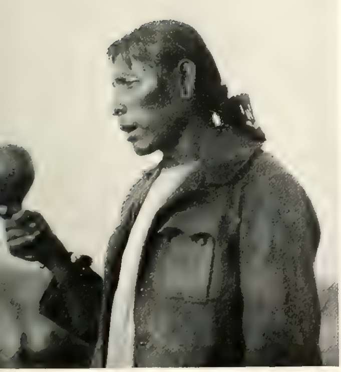


(Above) **THE NATIVE DOCTOR is seen blowing on a patient to expel the evil spirit causing the disease**

ANYONE who has ever spent a night in the Chaco near an Indian camp will always remember the melancholy chants which, at dusk, fill the silence of the forest. They are produced by the medicine men who come to attend their patients after sunset. If you walk through a village then, you may see one by the dim light of the fire bending over a sick man, now entoning his monotonous chant, now stopping to suck the inert body until the skin is bruised or even bleeds. The operation is accompanied by energetic blowing, spitting, and mysterious muttered words and grunts. Suddenly the shaman gurgles and, retching as if he were about to vomit, removes from his mouth a thorn, a hair, or a live insect, which he shows the awe-stricken audience with the pride of a surgeon exhibiting a particularly fine appendix to his assistants. Alas, this is not the end of the treatment; in a moment the doctor begins again with renewed vigor and works until he has extracted another thorn or beetle from the afflicted limb. After several hours of hard labor he stops and generally predicts a prompt recovery.

The cure may take other forms, but this is the basic treatment for most diseases. Illness is almost invariably attributed to these odd objects which are thought to have been injected into the body of the victim by some malevolent witch. Whenever an Indian feels some discomfort, he immediately senses the threat of an obscure but hostile will.

The anger and resentment of a fellow tribesman are masked under the appearance of harmony, but for that very reason everyone is exposed to secret vengeance. A person who has been unintentionally offended or someone simply jealous of another's good luck can always give vent to his ill will by practicing black magic. Having stolen an object belonging to his enemy, he submits it to the treatment he wishes to inflict upon the unsuspecting owner. Or, if the plot is carried out by an expert sorcerer, the victim will be shot by invisible missiles, which penetrate his skin without causing any lesion. Once in the body, these effect their material appearance and, if they are not removed in time, cause death as surely as bullets would.



(Left) **"CHIEF NEGRO" shaking the shamanistic rattle, which is widely used in ceremonies**

ALFRED MÉTRAUX was born in Lausanne, Switzerland, in 1902. As a student of history, philology, and anthropology he attended the Sorbonne in Paris and the Göteborg Hogskola in Sweden. He holds a doctor's degree from the Sorbonne and is a graduate of the École des Langues Orientales Vivantes (African section).

For five years Doctor Métraux was the director of the Instituto de Etnologia de la Universidad de Tucumán in Argentina and editor of the *Revista del Instituto de Etnologia*. In 1934-35 he was the head of the Franco-Belgian expedition to Easter Island. During the next two years he worked as a Fellow of the Bishop Museum at Honolulu, and in 1938-39 he was a visiting professor at Yale University. From 1939 to 1941 he was a Guggenheim Fellow.

At present he is on the staff of the Bureau of American Ethnology of the Smithsonian Institution, Washington, D. C., where he is working on the *Handbook of South American Indians*. He has traveled extensively in the South Seas, western Africa, and South America, particularly in the Gran Chaco and in the Bolivian highlands.

[illegible] which he said hurt him. The pain was slight, and there was no apparent infection; nevertheless, I yielded to his insistence and, hoping to comfort him, cleaned his foot with alcohol and scratched it lightly with a steel pen. Several hours later the man returned with a bright face and told me he was cured. He said he had heard a "shushing" noise and had seen black insects hurriedly leaving his limb. He explained that the liquid I had put on it had made the place too uncomfortable for the "beasts."

[illegible] of violent headaches. I gave her aspirins, but when these brought no results I advised her to call the medicine man. He ordered her to shave her head and then [illegible] me a huge beetle tied to a thread, which he insisted [illegible] fact, when I saw the girl in the evening, she looked cheerful and well—"without the bee in her bonnet"!

The interpretation of disease as an intrusion of something into the body is at the root of the desperate fear shown by the Indians when a European doctor [illegible] take medicines enthusiastically or who willingly undergo operations, become panic-stricken when a doctor approaches them with a syringe. They cannot be persuaded that any good will come from something that is *injected* into them.

I was told repeatedly by shamans that poisonous animals, such as snakes or spiders, kill people not by biting them but by actually getting into the body of those whom they attack. A little boy with whom I [illegible] from spreading, but the Indians who had rushed to help the child did not approve of my endeavors. Several men chased the serpent and managed to kill it. They placed it next to the boy, remarking that even though the snake was dead its spirit was still alive and ought to know what had happened to its body. A shaman immediately started to chant. "Here I am," he cried, "I pray you, O serpent, do not do any harm. The poor little boy! Please go away!"

The serpent was supposed to have answered, "Well, I shall go. I have found my son, but first I want to be paid."

To satisfy its demands a woman hung necklaces over the patient as symbolic presents for the murderous snake. The shaman then proceeded to suck the skin of the boy's whole body with as much energy as he could muster. At last he spat into his hand and, pointing to a piece of mucus, he told me with a glimmer of pride in his eyes, "Look, these are the fangs."

He went on and after a while showed us the eyes of the snake and some of its vertebrae. I was completely baffled. After the cure had been completed I asked him how it could be that he had extracted the snake piecemeal from the patient's body when, in fact, the dead snake was already lying there in plain view. He insisted that it was the spirit that had entered the patient, but he could not account for its materialization; somehow the second snake both was and was not the same as the first one. Actually the cure was a great success.

There are other conceptions of diseases. They may also be invisible demons. The ugliest of all is Smallpox, who has a swollen head riddled with little holes. He lives in a cave in a mountain and travels at night looking for Indian camps. During a smallpox epidemic which I witnessed in the Chaco, the Indians had killed all the dogs lest their barking attract the attention of the hideous spirit.

When a demon has entered a person, the shaman organizes a dance in which the spirit invariably joins; after a while he tires of jumping about and begs to be left in peace. The shaman may also try to bribe the disease-demon by giving him whatever he wants. The spirit, when asked, generally demands a gun, an ornament, or some food. All his requests are satisfied at once, with the understanding that he will be content with the image—the "shadow"—of all these goods. To make sure that the spirit will not stick to the real offerings, the shaman blows on them heartily. But since the disease-demon may also have inserted some object into the patient's body, the medicine man must proceed with the usual sucking and blowing.

Many ailments result from the loss of the soul, which may have been kidnapped by an evil sorcerer, or, more exactly, by his soul. Kedok, one of my informants, told me that once when he was ill he consulted a famous medicine man. After much rattling and muttering, this practitioner declared that Kedok's soul had been taken captive while wandering abroad during his sleep, and that it was now imprisoned in a jail. The shaman went to its rescue. After flying to the sky and penetrating the earth he finally discovered it in a far-away place. Before getting it out of its predicament, he asked a handsome sum of money. He managed to liberate the soul, but as poor Kedok did not recover, the shaman had to admit that it had been re-taken. Finally Kedok turned to a real doctor for help and was cured.

Shamans are primarily doctors. Their essential function is to cure people, and all other activities are secondary. No one can become a doctor, however, without having been chosen in some mysterious way by a spirit. A man may be walking in the bush without thinking of anything in particular when suddenly he meets such a spirit. As a rule he does not realize that the friendly person who talks to him and accompanies him is a supernatural being. His new friend follows him into his hut and speaks until he falls asleep. Then the man dreams and sees in its real form the spirit which tells him that in the future he will be able to "chant" (that is, to "cure"), providing he spends some time alone in the bush. The person thus favored generally complies with the instructions given him and after a month knows the "proper songs."

One of my informants gave me the most colorful description of the novice shaman's experiences during his period of fasting and mortification. Whether this picture fits the facts I do not know. It is perhaps an ideal that no one entirely realizes. The apprentice shaman's food consists of small birds, a diet which he varies occasionally by eating raw dog meat, preferably dog's ears. "He becomes exceedingly lean and weak and for 20 days he does not stop trembling." He sings continually as if moved by a superior force. It is only when the urge to sing has died down that he emerges from his condition of semihallucination.

The vigil of the novice is followed by a ceremony in which an old and experienced shaman communicates to him his magic power. He comes close to the candidate and asks if he wants to become a medicine man. Then, addressing a magic stick, he orders it to enter him. The initiate crumbles as if struck by lightning. When he recovers he intones his chant. Henceforward he is a full-fledged shaman and can hurl at his enemies the missile housed in his entrails, or extract the projectiles which have wrought havoc in the body of a patient.

A shaman is also a man who has a familiar spirit which he consults when he wishes to know the future or when he must accomplish some difficult task. He crawls under a blanket and invokes his supernatural servant; after a while he begins to shudder and feels a shock as if someone had struck him—the spirit has taken possession of his body. He then carries on a long conversation with it and learns the secrets hidden from the common people. Quite often the possessing spirit urges the shaman to commit crimes. "I wish that such-and-such a man would die," says the evil one. "I wish that so-and-so would get sick." The shaman must abide by these orders.

Shamans, of course, ask fat fees from their clients. They rationalize their greed by contending that, if the patient fails to pay, not only will he become sick again, but, in addition, the insulted spirit will punish the shaman for his unselfishness.

The Mataco Indians have associated magic ceremonies with Catholic rites and, of a shaman who is invoking the spirits, they generally say, "He is saying mass."

The Mataco shaman sometimes changes himself into a white bird, or, more exactly, his soul is transformed. He does this by snuffing a powder prepared from the seeds of the cebil and by playing a flute made of bird bone.

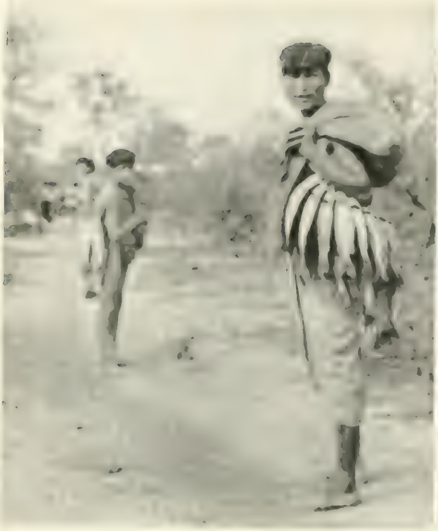
Once turned into a bird, he flies up into the sky, "just like an airplane" a modern-minded Mataco explained. The purpose of such a magic flight is to attack another magician who has kidnapped a soul and to force him to give it back. If men were clear-sighted, they could see in the sky the battles of the shaman's souls which, disguised as birds, pounce upon one another with the utmost ferocity. Shamans also fly to the sky to ask Rain to come. An Indian told me that the white people would have lost all their cattle if the shamans had not succeeded in convincing Rain to visit them.

Of all the celestial bodies the Sun is the most useful being that shamans may consult, but as he grows very weary of the many visits they pay him, he isolates himself and makes access to his abode as difficult as he can. Shamans, therefore, prefer to call on him in groups led by some famous and experienced man. If the wandering souls of medicine men meet those from other villages, they fight, and shamans whose spirits have been wounded or killed will inevitably fall sick or die, for whatever happens to the spirit must affect the body as well.

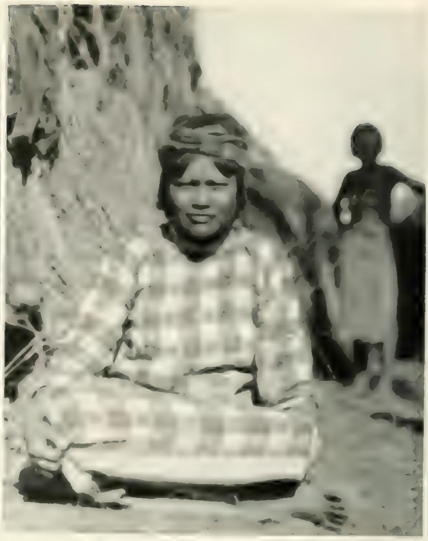
To protect the entrance to his hut, the Sun has made the trail leading to it slippery. Those who step on it, slide down and break their necks. Clever shamans know how to overcome the obstacle—by transforming themselves into wax they manage to stick to the trail. The Sun closes the gate of the fence surrounding his house with a trap made of two beams which move to and fro at such great speed that those who pass between are crushed. Skillful shamans change themselves into hummingbirds and fly unharmed between the onrushing beams before they meet. There are other traps within the gate in which naïve travelers are ensnared, but those who turn into eels slip through easily. The last obstacle is a palisade of cacti, which powerful shamans pass either as birds that fly over it or as rats that dig under it.

The Sun is generally perplexed by the visits of shamans who so easily dodge all his traps and snares. Every morning he strolls out to inspect his defenses and is amazed to find so few victims. This means that he must often go hungry.

Nevertheless, once a shaman has evaded the last trap, the Sun is no longer angry but receives his guest cordially. He even carries courtesy to the extreme of snuffing out his beams so that the visitor may come



A FISHERMAN of the Mataco tribe shows a good day's catch



THIS GIRL belongs to the Toba tribe, also of the Chaco

A BROAD GRIN is possible even in the difficult life that is led by the Pilagas

The native mother recognizes that all time is playtime

The shy Toba girls watch the scientist with mild wonder
Photo by Guy Serge Métraux

[illegible]

[illegible] which they fly in the form of an owl, a bird with lanterns in his eyes. After passing the obscurity, they turn into aquatic birds with red-circled eyes to continue the trip. Finally they take the appearance of "beauti- [illegible] dry forests, but the cautious medicine man always dis- [illegible] questions, he returns home enriched with a wealth of information.

When the Indians are approached by missionaries, they will abandon their shamans if they are offered [illegible] medicine man that the missionary gains the confidence of the natives. The eagerness with which the Indians accept treatment at the hands of European doctors is certainly surprising: they even carry their enthusiasm to the point of consulting the practitioner when they are in good health.

That their attitude is still governed by magical ideas is clearly shown by the importance which the Matacos, for instance, attribute to the stethoscope. No treatment is valid unless the mysterious instrument has been applied against the chest. Some people refused to see the doctor at their mission and traveled for 30 miles just to be put in contact with the all-powerful black tube.

Shamans, of course, resist the new ways as long as they can and, when they are converted, it is often with the hope that they will share in doling out the white medicine. I knew an Indian who opened a practice of his own. He was selling medicine in real druggist's bottles and even ordered pills from wholesale stores. His most powerful instrument was a pair of dark glasses, which he always put on before examining a patient. He claimed that with them he could see a person's insides. His reputation was particularly well established among the Argentinians living in the region, and every day patients, some of whom had traveled for two or three days, flocked to his cabin. White people referred to him simply as "the doctor." Once in a while Senor Doctor had to come to the mission to dictate a letter to his druggist, for he himself could neither read nor write.

The case is typical. In the end, surprisingly enough, even the white people in the neighborhood not infrequently become the shaman's clients, both the wealthy and the poor. How often have I heard a storekeeper or rancher who had suffered from some strange ailment, tell me that after consulting the most famous physicians in town to no avail, he had finally been cured by a local shaman.

It is no mean tribute to the old shaman, who has lost everything else, that the white invaders have turned to him in their hour of need when they felt powerless to fight disease and death.

(Above) DAUGHTER of the great chief of the Pilaga with her newly born baby, of whom she was extraordinarily proud

(Below) THE TOUGHEST field hockey player among the Pilaga

(Below) THIS TOBA YOUNGSTER donned his most "beautiful" suit to have his picture taken

A NOTORIOUS CHARACTER among the Toba girls who was always ready to pick a fight with other girls and was as pugnacious with her tongue as with her fists

A LONELY WARRIOR at an Argentinian fort who combined a military coat with war paints and a feather: one of the best hunters and "soldiers" of his band

YOUNG CHUNUPI GIRL, refugee from the Paraguayan war front, showing a reluctant baby

SEEIN

Photographs by Winthrop N. Davis

The Sphin

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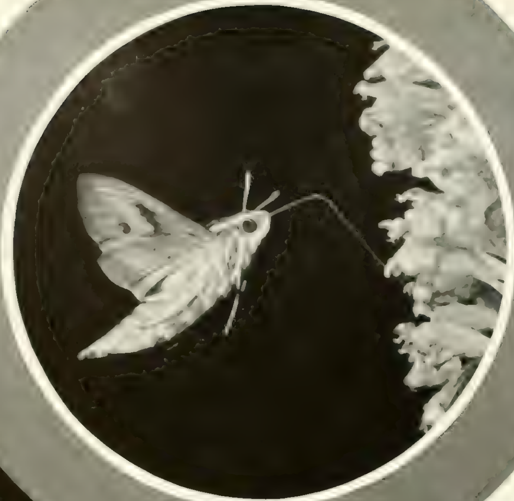

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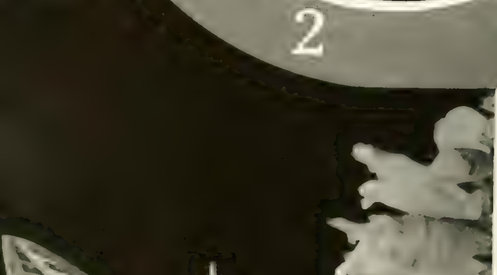

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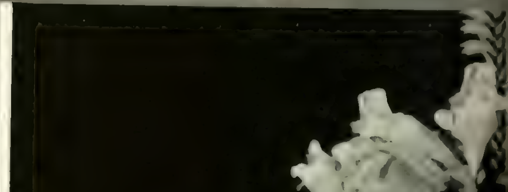
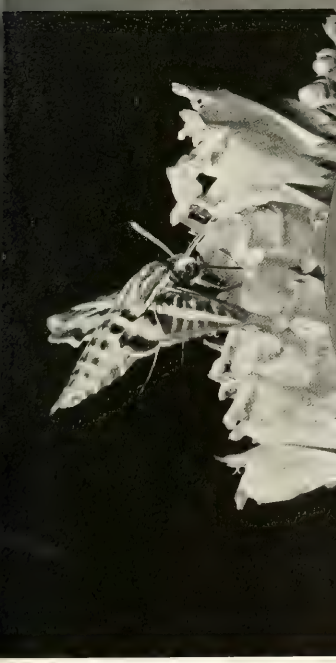


NATURE *through* the CAMERA'S EYE

THE marvelous possibilities of super-speed photography are clearly demonstrated by these five pictures. They reveal a process which takes place in thousands of back yards yet had never been clearly viewed by the human eye. The photographs were taken with Kodatron Flash Tube at 1/30,000 second. Mr. J. R. Davey, who submits them, writes: "I have been interested in high-speed lighting technique as applied to nature photography for the past year or so. Last summer I was able to lend my camera and lighting equipment to my brother, who is a senior medical student and has entomology and ornithology as hobbies. He took the photographs in September at Jackson, Michigan, where the white-lined sphinx moth *(Deilephila lineata)* is abundant around gardens."

Moth takes a drink

4



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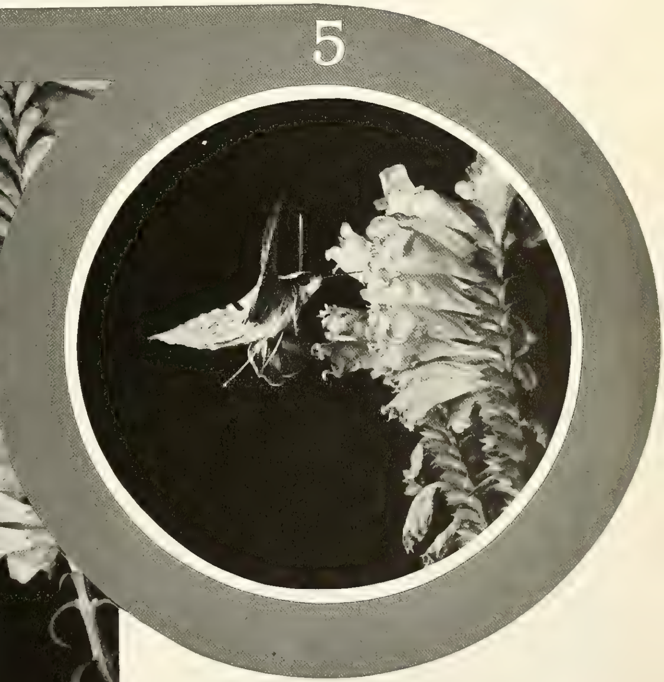
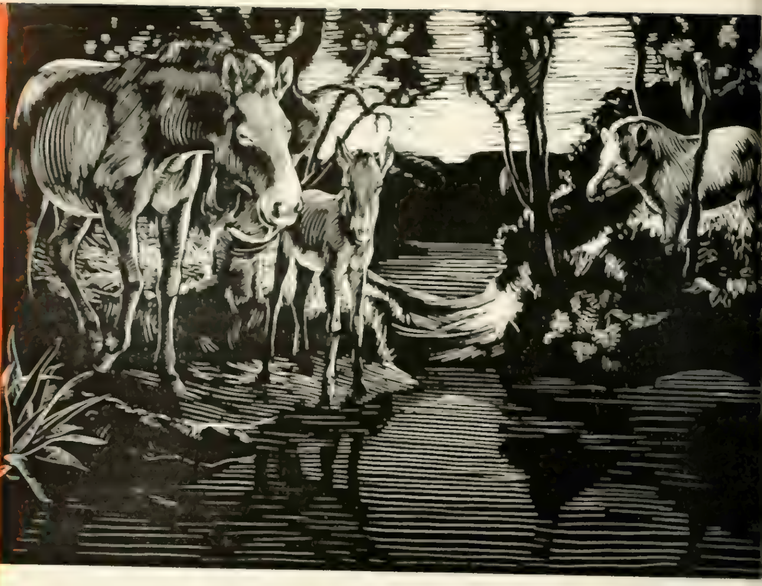
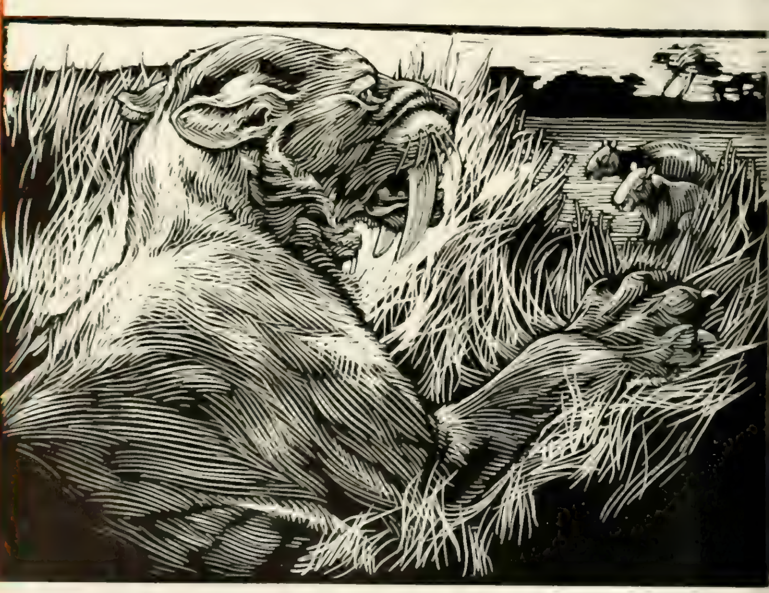


LONG BEFORE WHITE MAN set foot upon our shores, horses and tapirs had left North America, presumably for "greener pastures." But while the fourth great glacier was refrigerating most of the continent, both these plant eaters were content to bask in Florida's mild climate.



DRAWINGS BY
MARGARET COLBERT

ICE AGE WINTER

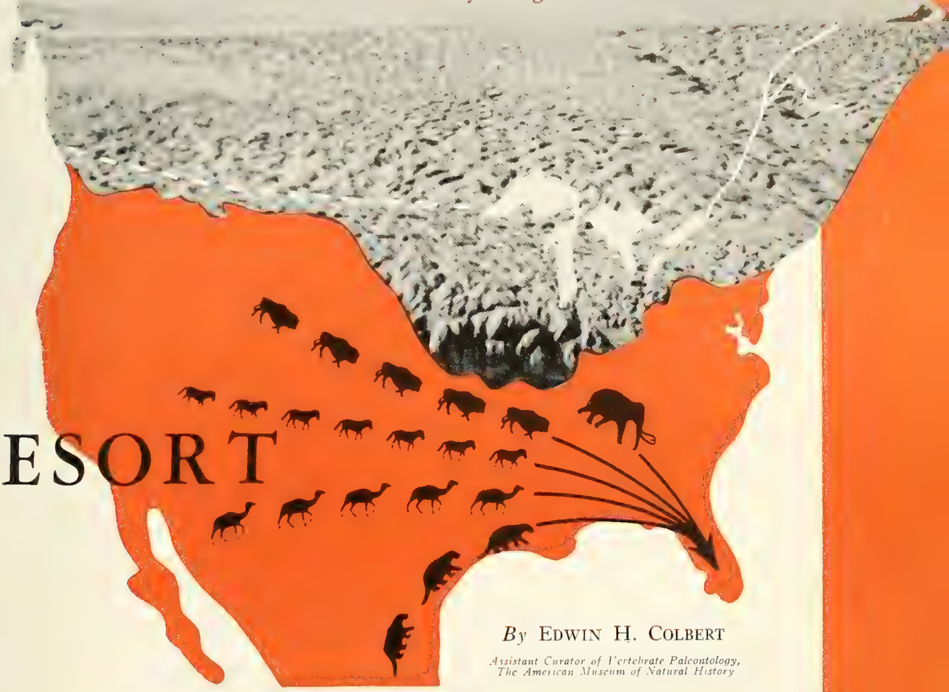


ARCH-PREDATOR of the Ice Age was the powerful sabertooth. Small-fry ice refugees—the otters, skunks, weasels, etc.—lived in terror of this giant cat. The capybara (*right*) found a haven along the Floridian streams. Though extinct in North America, this colossus among rodents persists in South America.

Last installment in the story of animal life

Driven south in a spectacular population movement by relentless glaciers that descended upon North America, the animals discovered Florida's warm haven a million years ago

RESORT



By Edwin H. Colbert

Assistant Curator of Vertebrate Paleontology, The American Museum of Natural History

About a million years ago there began a series of new events of profound importance in the history of the earth. From the north, tremendous glaciers—icecaps of continental proportions—began to creep slowly southward to engulf the greater portion of North America, while at the same time in Eurasia, there was a similar southward advance of the ice sheets. These glaciers of the northern hemisphere pushed unceasingly down to the middle latitudes, and then, just as mysteriously as they had begun their advance they halted, and finally retreated to the polar regions from whence they came.

Four times this great encroachment of the land by continental glaciers occurred, and North America, Europe, and northern Asia became regions of polar frigidity. Four times the glaciers retreated and the northern continents became warm again. It is in the last of these glacial retreats, which began some 30,000 years ago, that we are now living. We are the inhabitants of a warm interglacial age, and there is no reason to think that our descendants, in the dim future, may not witness another southward push of the ice, inevitable and relentless. All of which is in explanation of the latest events in the long history of the earth, the great Ice Age which is known as the Pleistocene.

Obviously the first glacial advance, bringing with it cold, arctic conditions, was bound to have some effect upon the animals living in the northern continents, in North America, Europe, and Asia. The long period of gradually changing environmental conditions described in last month's issue of Natural History was at an end; here was the beginning of a new epoch, a period of relatively rapid changes in environment. To the new conditions the life of the earth had to adjust itself.

As has already been shown, many types of strange animals became extinct near the end of Pliocene times, [illegible] the glacial [illegible] [illegible] [illegible] [illegible] of the [illegible] [illegible] [illegible] of late Pliocene times. Contemporaneous with the beginning of the Ice Age in the northern world many "modernized" types of mammals had made their debut upon the stage [illegible] which were fitted by their adaptability to withstand the rapid and [illegible]

The horse and his relatives the asses and zebras appeared with the advent of the Ice Age. So did the camels and the large deer of our modern world. So did the various cattle, and with them a host of antelopes and gazelles. So did the elephants. Indeed, the sudden appearance of these new, modernized types of animals affords one of the convenient ways for recognizing the opening of the Ice Age throughout the world. The words "throughout the world" give a true impression, for a striking feature of this period was the great intercontinental and in some cases world-wide movements of certain types of these new, modern mammals. Let us look for a moment at these "migrations," if so they may be called.

The horses had evolved in North America during the long reaches of the Age of Mammals. Suddenly with the beginning of the Ice Age they broke from the confines of their homeland to spread through virtually the entire world. To the south, they pushed across the newly-established isthmus to occupy all of South America. To the west, they poured across a land connection which at that time bound Alaska to Siberia, and spread throughout Eurasia, the Orient, and Africa.

With them went the camels and their relatives. The llamas, alpacas and their ilk went to South America, the large camels to Asia, the Orient, and Africa, again utilizing the Isthmian and Bering crossings which connected the continents.

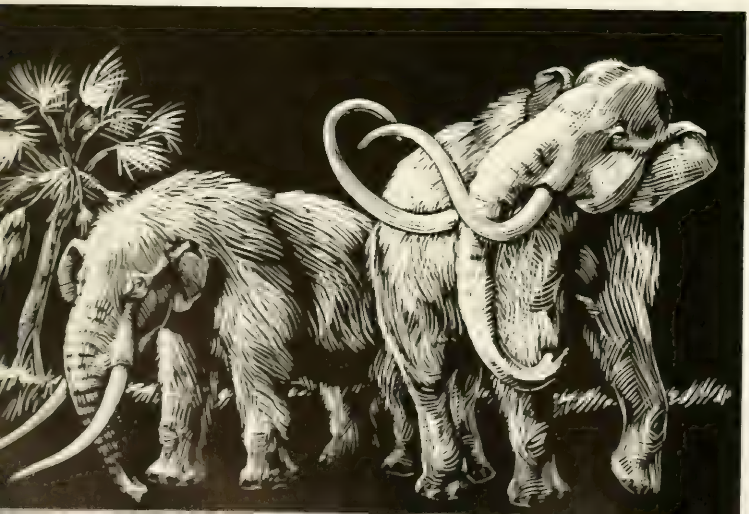
But all of the movements did not originate in North America, for there were corresponding flows in the other direction. The elephants, whose Pleistocene representatives are known as mammoths, originated in the Old World and crossed the Bering Bridge into the New World to occupy all of North America. With them came the cattle, specifically the bison, an immigrant which we think of as being the veritable symbol of America.

Bears and large deer also came from the Old World into the Western Hemisphere, although forerunners of these animals already inhabited this region; while from the opposite direction gigantic ground sloths, which had been evolving in South America, crossed the Isthmus to take up a new abode in a northerly environment.

These are only a few of the great movements of animals that took place with the coming of the Ice Age, but perhaps they indicate the extent to which the early Pleistocene was a period of animal migrations. Newly evolved animals pushed from one land to another, from north to south and south to north, from east to west and west to east. It seems as though a shuffling of animal populations was necessary to strike a new balance in the changed world.

These were the great movements that heralded the opening of the Ice Age. But what happened after these initial phases of the Pleistocene period had run their course?

We have already seen how there were four glaciations, how the ice advanced four times from the north polar region and how after each advance it retreated to the far north again. With these advances and retreats of the glaciers there were corresponding movements of the mammalian populations. As the ice came down from the north the mammals withdrew southward ahead of the glacial front. Then, during the interglacial stages, as the ice retreated to polar regions, the mammals spread northward again to occupy those regions from which they had been driven by the polar cold. Thus the Pleistocene animal populations may be thought of as pulsating communities, ebbing and expanding as the glaciers advanced and retreated, constantly shifting back and forth as the



MASTODONS AND MAMMOTHS also pushed their bulky weights to the Ice Age Winter Resort. Though conditions seemed ideal for their continuation, both disappeared from earth—leaving science with still another tantalizing "why?"

environment changed. Theirs was a life of rigorous changes, not within the experience of the individual it is true, but within the existence of the species. Such was the story of mammalian life in North America during the fluctuating course of the great Ice Age.

In all but one corner of North America—for in one small area the history of mammalian life seems to have differed from its general course over the rest of the continent. This is in what we may call the Ice Age Winter Resort—the peninsula of Florida.

As the glaciers pushed down from the north and crowded the animals before them, the influx of life into the southern portion of North America caused added pressure and competition during the glacial stages. Somewhere, somehow, a balance must be attained, or the pressure of animal populations would reach an explosive state. This balance was found, very likely, in the "safety valve" of Mexico and the Central American region. As the animals pushed in from the north, the southern animals retreated as best they could into the lower end of the North American horn. Thus by constant movements and adjustments the various animal populations could become more or less established in progressively smaller areas.

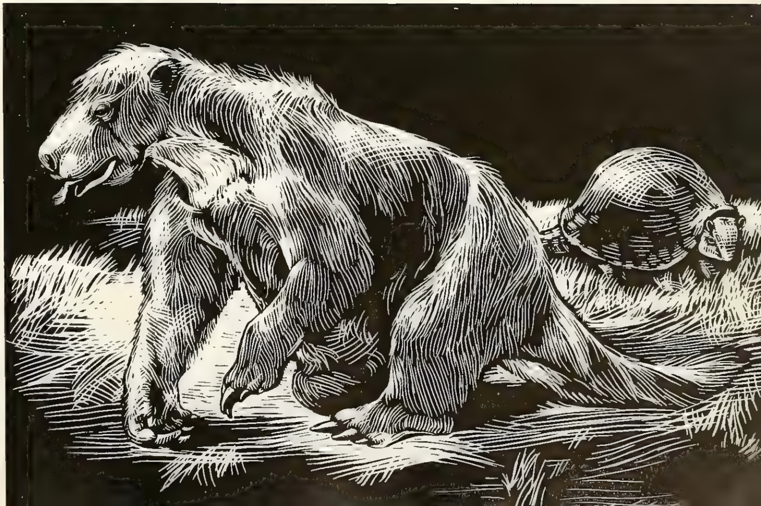
But on the eastern side of the continent such adjustments could not be made. Florida offered a warm haven for animals driven south by the polar cold, but it was a "dead end." Moreover it was a relatively small area, so that its accommodations for immigrating animals were necessarily limited. Consequently there seems to have been little penetration from the north, and life went on in Florida during the Pleistocene undisturbed by the flowing and ebbing glaciers. Here was an old-fashioned environment, with the rather monotonous conditions of existence that had prevailed over much of North America in earlier geologic ages. Here the tenor of life continued much as it had in the past.

To the eye of imagination, what would the Florida scene of that age look like? Very much as it does today, with certain additions. As in present-day Florida, there would be a host of small animals inhabiting the underbrush and hammocks, scurrying through the grass out of sight of the predator's eye. Here would be opossums and shrews, rabbits and various kinds of wild mice, muskrats, and squirrels. But splashing around in the streams in decided contrast to his tiny rodent brethren would be the large capybara, the giant among the rodents, now living far to the south in South America.

There would be numerous hunters such as are found in Florida today, the gray fox, skunks and weasels, raccoons, otters, and lynx. But dominating these pilfering seekers of small prey would be great, powerful predators such as one would hardly care to meet at close quarters. Fierce wolves would be seen loping across the hard open ground, while gigantic bears, long since extinct, would be found in the thickets. Great cats would be seen gliding through the forests like wraiths: the jaguar, found now in lands to the south, and the powerful saber-toothed cat, arch-predator of the Pleistocene, which disappeared from the earth thousands of years ago.

It is among the more peaceful types of animals, the grass-eating and browsing forms, that the Pleistocene fauna of Florida would seem strange to our modern eye. First one would encounter the bizarre giant ground sloths and the glyptodonts, immigrants from the south and cousins to the armadillo, an immigrant that still lives in this region. These were stupid and inoffensive animals, depending largely on their size for protection. The giant sloth probably could ward off the aggressive saber-toothed cat by using his hook-like claws, while the glyptodont, covered with a turtle-like shell, could pull in his head and offer passive but effective resistance to the enemy.

Then there would be the horses and tapirs, both living elsewhere today, but both destined to become extinct in North America long before white man set foot upon these shores. The horses fed in the open glades, while the tapirs, like their modern relatives, probably stayed along the streams, splashing through the water and browsing on the succulent leaves hanging over the banks. In the wooded stretches there



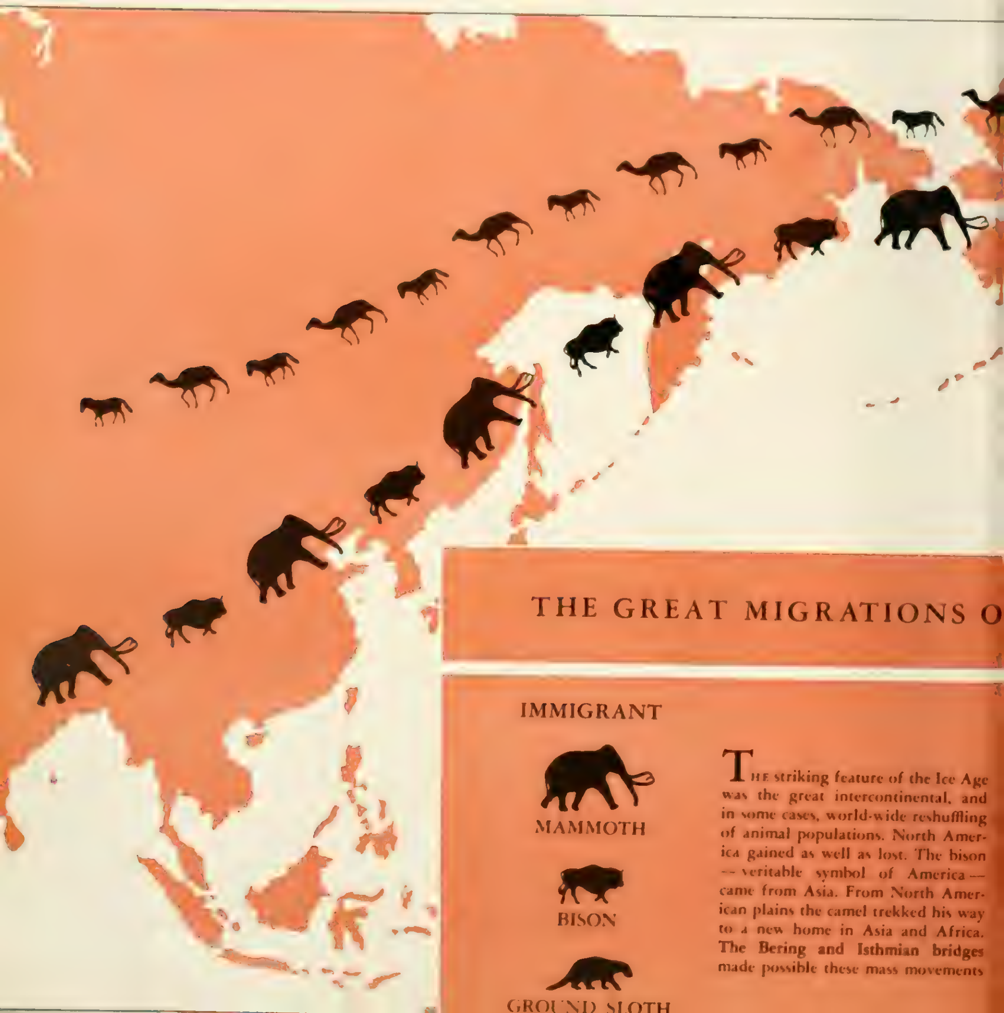
"Nails in his gloves." The hook-like claws of the giant ground sloth enabled him to ward off the attacking sabertooth. The turtle-like shell of the strange glyptodont (*right*) offered passive but effective resistance [illegible] [illegible] North America [illegible] [illegible] [illegible] [illegible] [illegible] Florida.

[illegible] animals, the mastodons and the mammoths, crashing through the forests and stripping leaves from the trees with their powerful trunks. These were the dominant but tolerant lords of the entire scene, afraid of nothing but the elements.

[illegible]

North America [illegible] of the Ice Age. The difference was that this picture [illegible] North America the landscape was altered by the advance of the glaciers. At such times many of the animals that enjoyed a relatively tranquil existence in the Ice Age Winter Resort of the peninsula were in other [illegible] muskoxen, giant beavers, and woolly mammoths.

Such was the Florida that was found by the distant forerunners of Ponce de León—the first men to [illegible] know. What we do know is that early man in Florida was



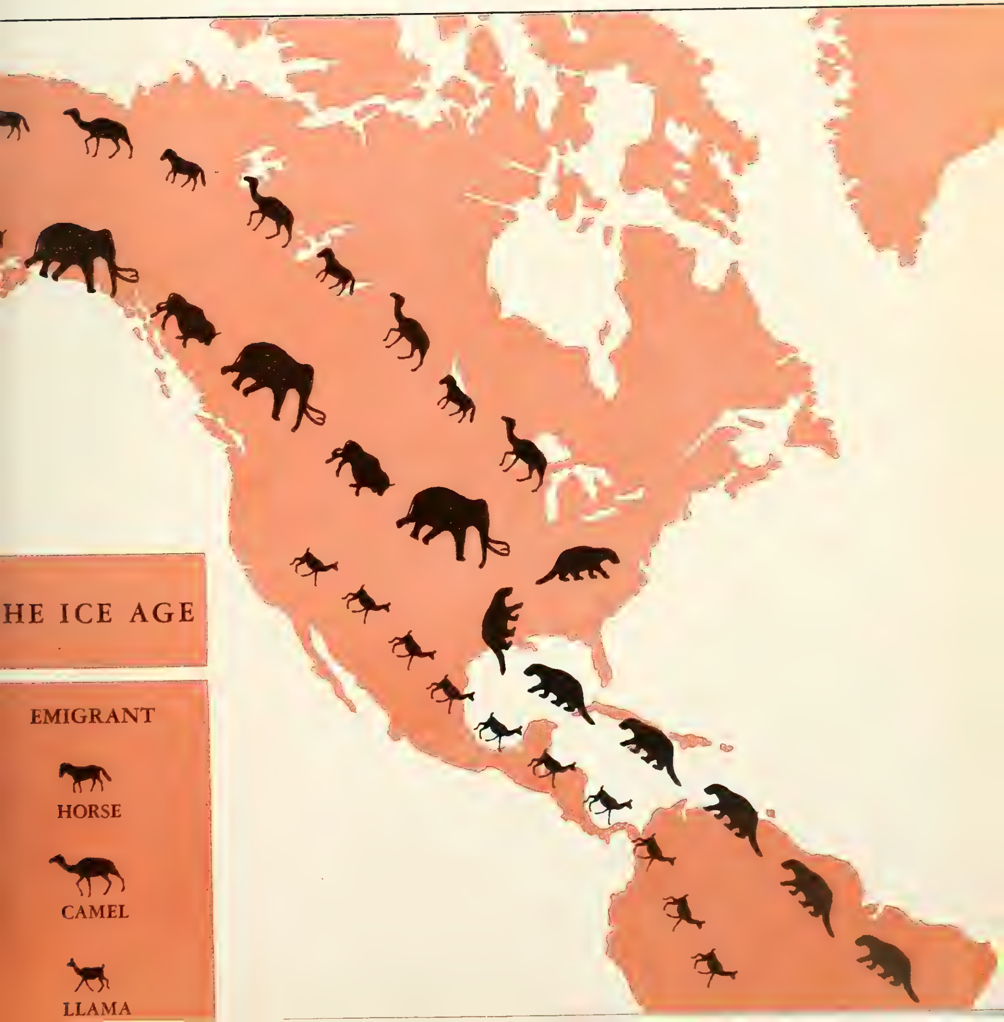
THE GREAT MIGRATIONS O

The striking feature of the Ice Age was the great intercontinental, and in some cases, world-wide reshuffling of animal populations. North America gained as well as lost. The bison — veritable symbol of America — came from Asia. From North American plains the camel trekked his way to a new home in Asia and Africa. The Bering and Isthmian bridges made possible these mass movements living with all of these animals, with the types which still exist in this region and with those giants which long since became extinct in this land—the horse and tapir, the capybara, the saber-toothed cat, the ground sloth, the camels, the mastodon and the mammoth.

Why should these animals have become extinct, particularly in a land that seemingly was so amenable and so well suited for their continuation? This is a tantalizing question to which we shall probably never know the full answer. Suffice it to say that the great, dominant mammals of the Pleistocene became extinct all over North America *after* the arrival of man on this continent. Did man have anything to do with their disappearance?

Whatever the cause, the fact is that they did become extinct, but not until after the last glacier had begun its retreat to the north. Thus the "modern" period of our earth history was ushered in. Florida, the Ice Age Winter Resort for the Pleistocene mammals became the winter resort for modern man. The rest of the continent, subjected to periodic alternating cold and warm epochs, again became temperate.

But are we at the end of the cycle? Who knows but that in some future period, some tens of thousands of years hence, our descendants, perhaps completely civilized by that time, will really find Florida more than a winter playground? Perhaps it will be for them a haven, far removed from the great, crushing front of the fifth continental glacier, riding down over our northern cities.



Death in the Desert

By Lake S. Gill

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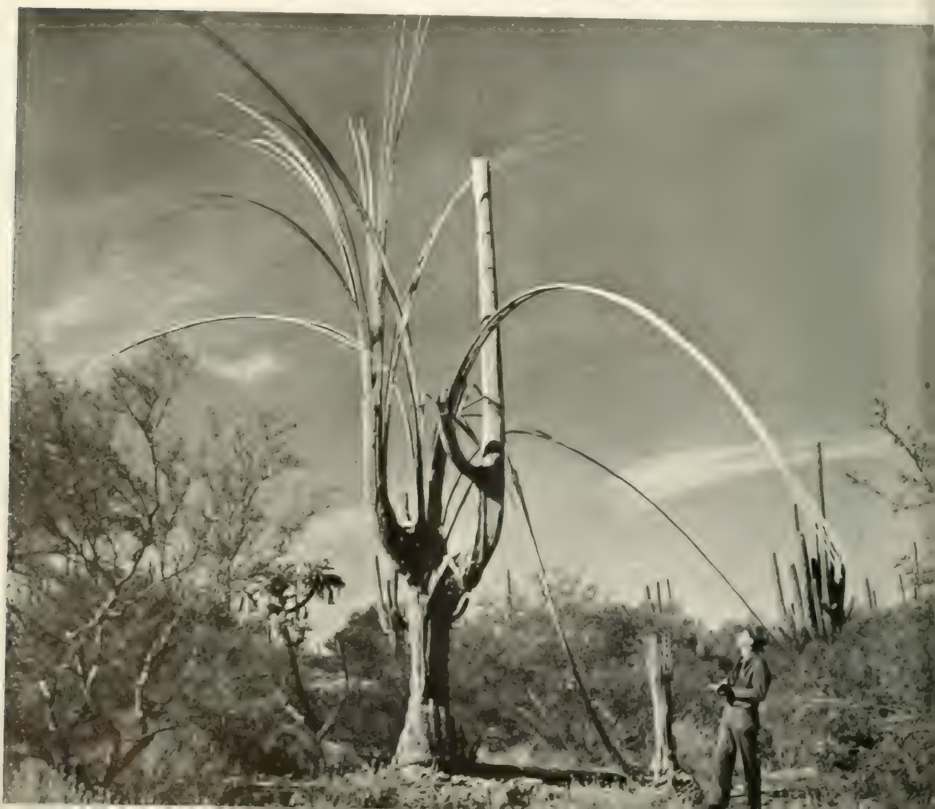
The giant cactus, which has attracted the interest of so many travelers in the Saguaro National Monument just east of Tucson, is one of the most picturesque features of the south-central Arizona landscape. Its purplish-red fruit is harvested by the Indians and is either eaten fresh or boiled down to produce a molasses-like syrup and fermented. Some of the oldest giants are estimated to exceed 200 years in age. Recently a virulent stem rot has threatened to exterminate the giant cactus. Measures are being taken to curb it, as shown in these photographs. The seriousness of the plague is apparent when it is realized how slowly fresh seedlings can replace the fallen giants. A ten-year-old saguaro is rarely more than five inches tall.

KILLED by a virulent rot that has attacked the picturesque saguaro cactus of the southwestern desert, the ribs of this giant sway in the wind



(Right) A ONCE PROUD giant tumbles earthward, pulled over by a truck where the least possible damage will be done to the desert shrubbery

THE giant cactus or saguaro [suh-wah'ro] with its grotesque body and clumsy arms, attaining a height of 40 feet or more, may be taken from the southwestern landscape by a tiny bacterium.

In the summer of 1939 Prof. J. G. Brown, veteran plant pathologist at the University of Arizona, noticed that the saguaros around Tucson and Phoenix were dying at an alarming rate. Suspecting that a transmissible disease might be rampant in the giant cactus forests, he immediately sought an explanation, and within a few months he discovered what appears to be the trouble-making germ. News of his findings aroused the concern of Arizona citizens who prize these plants highly.

The saguaro, technically called *Cereus giganteus* or formerly *Carnegiea gigantea,* has come to be emblematic of the Southwest. Its white wax-like blossom is the official flower of Arizona, in which State the species is mainly found. South of our border it is abundant well into Sonora, Mexico.

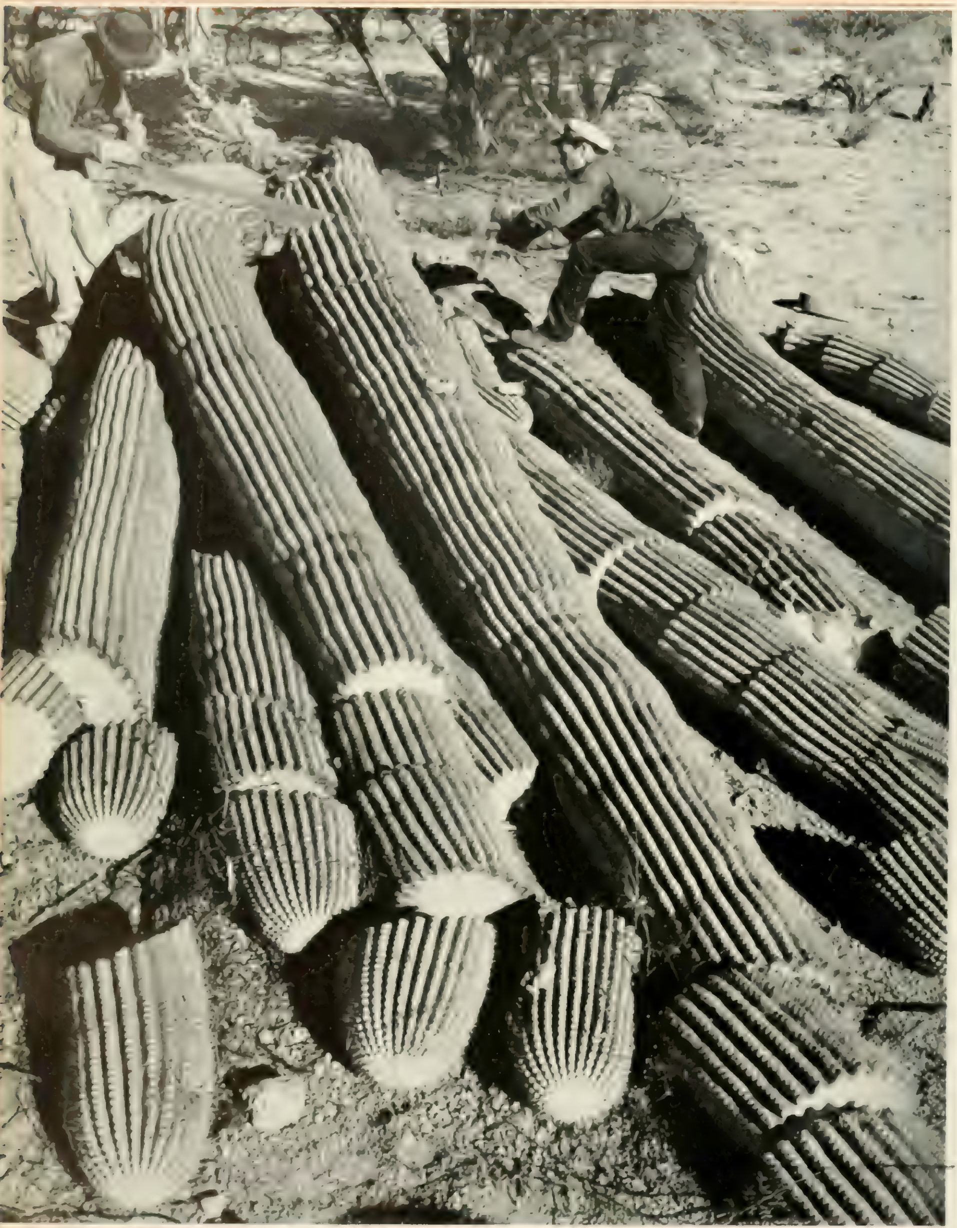
In addition to having great aesthetic value, the giant cactus affords food and shelter to the birds and mammals of its desert domain. The elf owl is said to live exclusively in holes made by the Gila woodpecker in the saguaro. The fruit is eaten extensively by coyotes and white-winged doves. Papago Indians make both a drink and a preserve from the delicately sweet fruit, grinding the tiny black seeds into a meal for their own consumption, or using them for chicken feed. The tough woody ribs are used in the construction of shelters and corrals, and in recent years have been employed in the production of knickknacks and novelty furniture. The stout sharp spines are sold for phonograph needles.

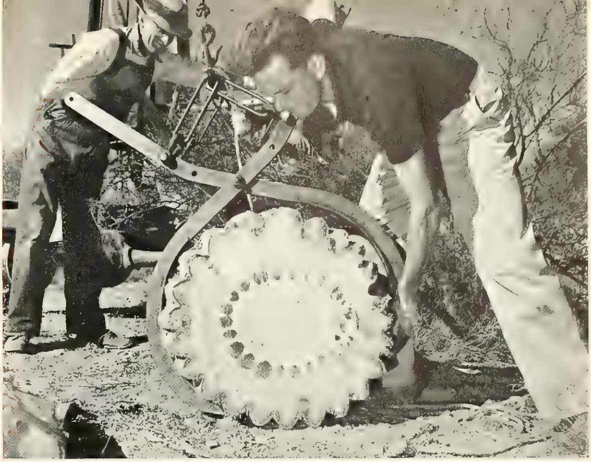
The cacti afflicted with this disease literally rot away. Their normally crisp, white, fleshy pulp turns brown, putrid, and slushy, and slips from the woody skeleton to the ground below, and there dries into a light crumbly mass. In early stages of attack, the putrified tissue is often confined to a pocket, sealed over by the tough outer skin of the cactus. Whenever this skin cracks, a sticky black liquid oozes down the outside of the plant. Sometimes open cankers form and slowly and insidiously enlarge until after many months they girdle and finally kill the cactus. In certain cases the rot may develop so quickly that there is no outward indication of disease until the decayed pulp suddenly slips from the entire skeleton, forming a sloppy heap upon the ground.

The National Park Service, custodian of some of our finest cactus forests, was among the first to ask how serious this disease was and how it could be checked. Last year the Bureau of Plant Industry, of the U. S. Department of Agriculture, joined the University of Arizona in a co-operative effort to answer

(Below) THE GROUND where a diseased cactus has been removed is sprayed with a bactericide after all debris has been removed. The skeleton in the forground is that of a giant that has been dead for several months; later this will be removed and burned

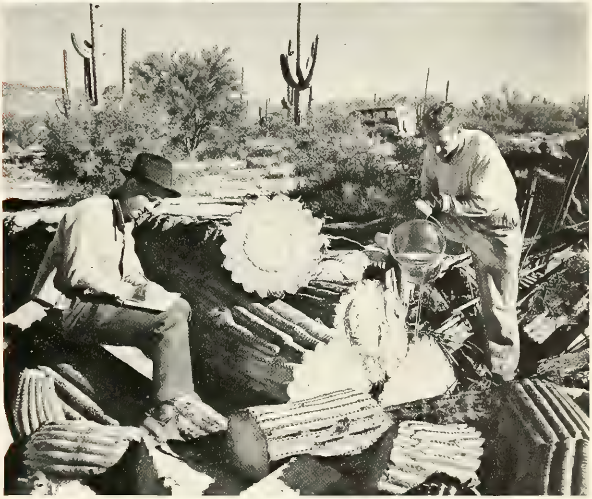
DEATH IN THE DESERT





(Left) In order to get the massive giant cacti to the burial pits in dump trucks, they are sawn into short lengths

(Right) A portable crane is used to load the large butt sections. This one, which was five feet long, weighed about 1500 pounds



After the sections have been dumped into the burial pit, a volatile insecticide is poured over them and they are then covered with tarpaulins for several days, thus forming a lethal gas chamber for any insects present that might carry the deadly disease germ

After fumigation, the sections are permanently covered with dirt

(*Above*) A WHITE DAUB of paint is the death warrant for a seriously diseased cactus in the experimental plot. Note the record stake at base of trunk and disease lesion in stem

these questions by field and laboratory experiments which should in due time yield the essential facts.

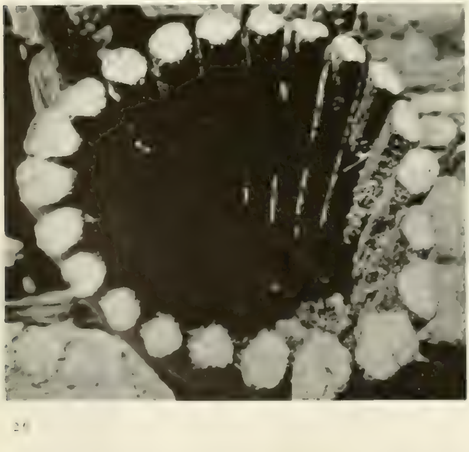
Professor Brown, with some assistance from the Federal Government, is making intensive studies of the germ he discovered. He hopes to determine its exact role in the disease, how it is carried, and whether it is a new and especially virulent parasite or a native organism, possibly one which constitutes only a temporary menace. For many years it has been known that saguaros seem to die of rot, but the casualties were so slight that they occassioned no alarm.

In preparation for the worst possibility—that a new disease was threatening to wipe out the saguaros in the same way that the chestnut blight exterminated the chestnut from eastern forests—, the Bureau of Plant Industry has started experimenting with suppressive measures. For the first test a square mile was set aside in the Saguaro National Monument east of Tucson. Diseased cacti in one half of the section were removed or treated, while the other half was left untouched for comparison.

In an ordinary plant-sanitation project, the diseased material would be burned, but this is almost impossible in the case of the saguaros, which contain more than 90 per cent water by weight and are extremely resistant to the hottest flame. Burial therefore, seemed to be the most practical method of rendering the badly diseased cacti harmless to the remaining stand. When the last of the 335 giants that had to be disposed of were covered with dirt, the skeletons and shriveled dry carcasses of the 1061 plants were piled in the graves and burned. The last vestiges of disease were then removed by operating on those cacti that were so recently infected that all rotten tissue could be cut out without seriously injuring them. Already there are indications that surgery applied at an early stage of the disease may effectively save a cactus from premature death.

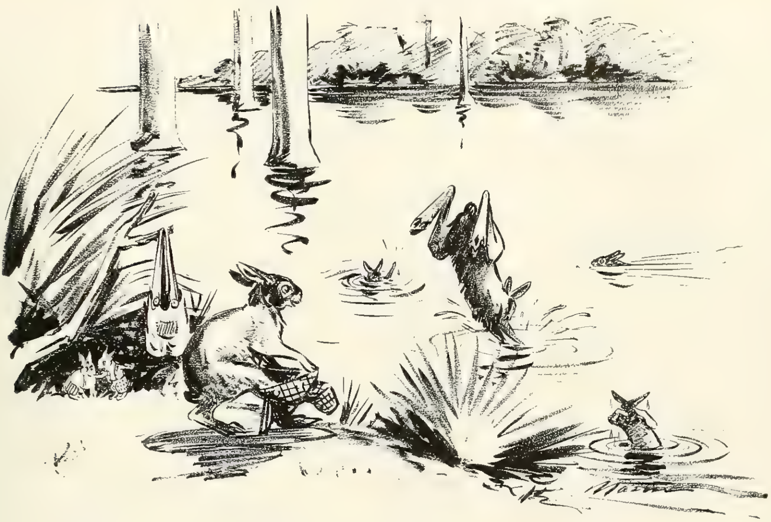
Each of the 13,125 cacti on the square mile has a numbered wooden stake at its base. These serve as identification marks for the case histories that are now being kept to determine the effectiveness of the treatment. Preliminary analyses of these records show that the death toll is heaviest among mature plants from 150 to 200 years old. If this age class only should be seriously attacked by the disease, it would take decades to restore the damage.

Saguaros reproduce by seed alone. The rare seed that manages to survive the vicissitudes of the desert is nearly always one that happens to fall beneath some hardy shrub. Shaded there and protected through the tender years, the young cactus is in time well-equipped to store away water for use during the droughts and able to shift for itself. It would seem that the giant cacti's way of life is already hard enough without having to cope with a devastating disease.



AFTER the outside pulp rots off and the central pith rots out, the tight hollow bundle of tough woody ribs that constitutes the skeleton of a dead saguaro can be used in the manufacture of unique furniture. Short bolts from large plants make interesting waste baskets; the skeletons from smaller plants are used for table legs or pedestals

RABBIT SWIMMERS



By JOHN ERIC HILL
Drawn by
G. FREDERICK MASON

Rabbits and their relatives generally avoid water and are as little given to swimming as cats. But in the southeastern United States, from the Dismal Swamp to southern Florida and west along the Gulf Coast to near Mobile, there is a species known as the marsh rabbit *(Sylvilagus palustris)*, which always lives in the moist lowlands and often goes swimming. A related species occurs in the Mississippi region, north to Illinois and southeastern Kansas and west to eastern Texas. In some parts of its range, this more western species is quite as aquatic as the marsh rabbit, but in other localities it is found in the dry wooded bottomlands, under conditions hardly different from those suited to the common cottontail.

Although most species of eastern North American mammals were known before the beginning of the nineteenth century, it was not until 1836 that the marsh rabbit of the Carolinas was described by Bachman. A few years later the *Quadrupeds of North America*, a work by Audubon and Bachman that established American mammalogy on a solid foundation, gave an account of the marsh rabbit's habits that comprised all that was known about this animal until recently.

The marsh rabbit lives in the low marshy regions, places that are subject to flooding by rain or tide, or near the permanent water of the great swamps. Here it makes runways and wades through the sticky mud or muddy pools. When going slowly the marsh rabbit often walks by alternate movements of the legs, instead of hopping as other rabbits invariably do. In swimming across pools and streams, it uses its legs in alternate strokes, somewhat like a dog, whereas the rare records of other kinds of swimming rabbits indicate that they move their hind legs together, as on land.

DO NOT MISS

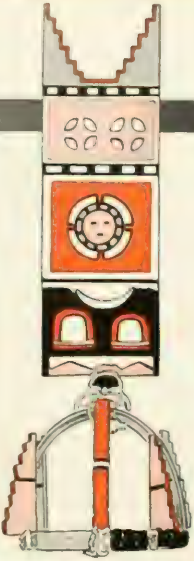
In **THE TALKING DRUM FROM MANGBETU LAND,** Dr. James P. Chapin, veteran Congo ornithologist, will recount an engaging series of adventures he had while securing one of the Museum's prized possessions from the Dark Continent. Dr. A. I. Good, who has resided for many years in West Africa, will explain for the first time in any popular magazine the system whereby the natives communicate by means of the drum.

•

In **DESIGN FOR SWIMMING,** G. Miles Conrad, the author of "The Film of Life," will examine Nature's varied bag of tricks for underwater locomotion and show how Man has applied her dynamic principles to such sinister agents of destruction as the submarine. A popular and thoroughly fascinating survey of the aqueous medium and the life it supports.

Although in some localities the habits of marsh rabbits are different, in the Carolina swamps they almost invariably take to the water for safety and swim with enough rapidity to escape from most dogs. A few years ago men on a dredge 700 feet from the nearest bank of the Savannah River were surprised to see a marsh rabbit swimming near them. No tide or flood could have brought it there, as far as could be determined. Apparently it was crossing the river just "to get to the other side." This seems to be a rabbit Marathon record.

Bachman told of seeing a number of marsh rabbits swimming about in a deep pool, "pursuing each other, as if in sport, and evidently enjoying themselves." Sometimes they hide in the water, almost like frogs, floating quietly with only their nose and eyes above the water and with their ears laid flat. And captive marsh rabbits like to lie partly submerged in water, especially in warm weather. In these habits they are not so different from ourselves in the "good old summertime."



A HEAD TABLET worn in Zuñi dances by women impersonating the Corn-maidens. (From an example in the American Museum)

ACCENT ON *HEADDRESS*

A brilliant array of tribal and ritualistic costumes are displayed at the ceremonials which the Indians hold each summer at various centers in the Southwest

PHOTOGRAPHS BY ANDRÉ DE DIENES

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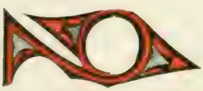
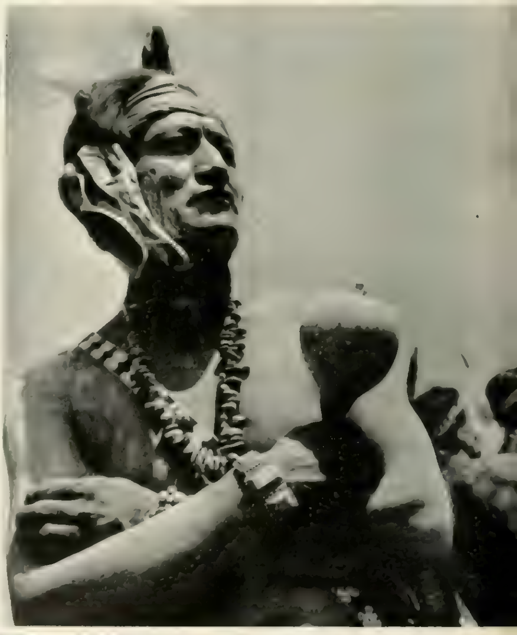
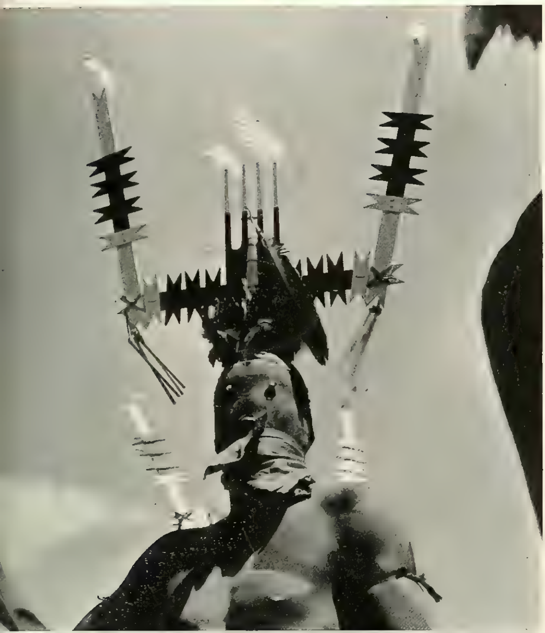
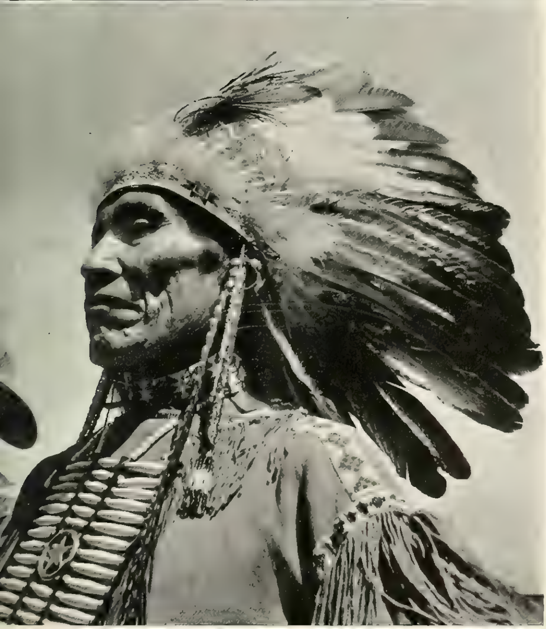
ZUÑI

THIS INDIAN with a gourd rattle and turquoise bracelet is from the New Mexican village of Zuñi, which is the sole remnant of a pueblo population of wholly distinct speech and unknown origin. Zuñi is the Southwest's largest pueblo. The greatest Zuñi ritual is the Shalako, named after a mythical tribesman of gigantic stature. *(Below)* A design from a woman's water jar



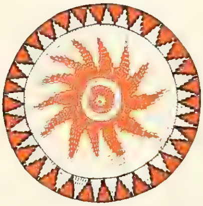






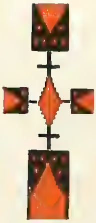
MESCALERO

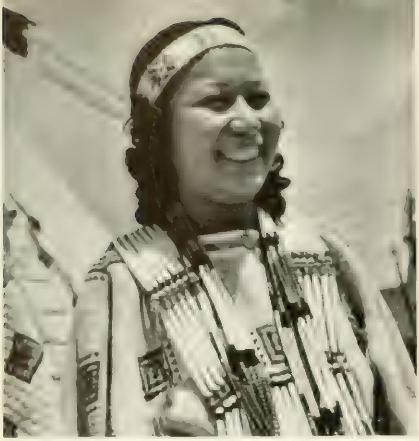
THE MAN at left is a devil dancer of the Mescalero Apaches, also of New Mexico. These Indians got their name from their use of the mescal, or century plant. They cook the trimmed stumps of the plant for two or three days in a pit and then dry the material and store it for future use. The design below is from a beaded tobacco bag and represents a wheel at a saw mill

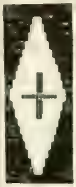


SIOUX

THE FEATHERED HEADDRESS has wrongly been made symbolic of all Indians. It was worn only by the Sioux, as at left. The Sioux occupied the Great Plains and lived largely on buffalo. The design below is an example of the beadwork of the Dakotas, a powerful tribe of the Sioux, who lived in what is now North and South Dakota. The personal decorations of their men were elaborate

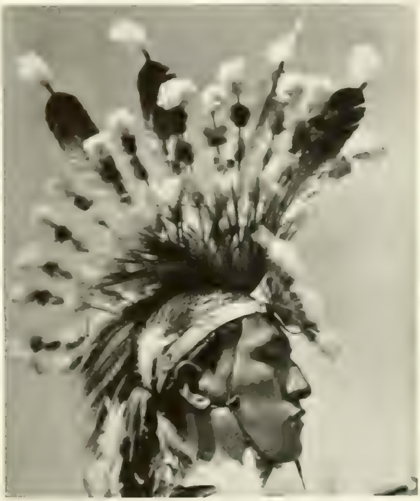






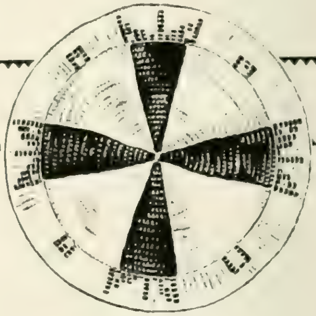
CHEYENNE

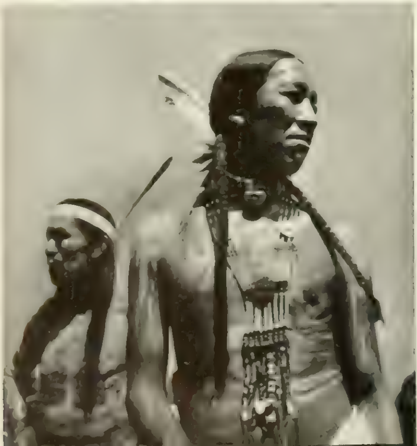
Quite like the Dakotas in costume and mode of life, the Cheyennes are chiefly interesting because of their migration from Minnesota to Colorado over a period of about two centuries. They now occupy reservations in southeastern Montana and Oklahoma. The girl at left is a native of Oklahoma. The design decorates the cover of a baby carrier in the American Museum, a wooden frame worn on the mother's back or hung on a saddle



TAOS

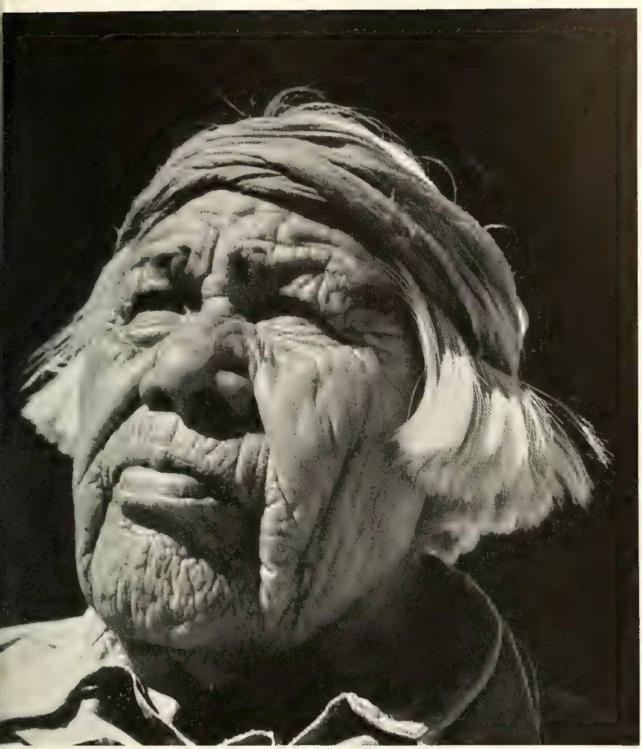
The Taos Indians are one of the northernmost pueblo groups inhabiting the headwaters of the Rio Grande in north-central New Mexico. These Indians are noted for their terraced buildings of sun-dried brick, with ladders communicating between the different levels. Modern Taos, from which the boy at left comes, is a popular art center. The design below is drawn from a bead decoration on a painted buffalo hide from Taos

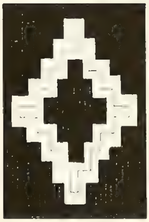




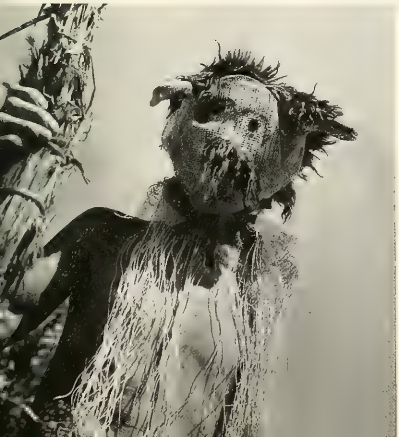
PICURIS

Only a few miles southwest of the Taos pueblo live the Picuris, another group of the artistic village dwellers of the upper Rio Grande. This pueblo region embraces two basic language groups and several well-marked dialects, but the Picuris and the Taos Indians speak the same dialect. Note the elaborate necklace worn by the Indian at left, an heirloom that would enhance any collection





NAVAHO



THE NAVAHO ABOVE, said to be more than 100, exhibits the cloth headband which his people characteristically wear in the most impressive colors. He could speak no English but was cordial and had no objection to having his picture taken. Ceremonial occasions require the Navaho to cast aside his simple but artistic daily garb and don a wide variety of weird costumes, such as that of the Mud Dancer at left. Though they were engaged in agriculture when first discovered, the Navahos have come to depend largely on flocks of sheep. They manufacture much of the wool into blankets which are sold for them by traders to tourists and others, who use them for rugs and house decorations. The design above is from a Navaho blanket of the "classic" type, with terraced patterns dominant

STRATEGIC METALS

NUMBER VI

ANTIMONY

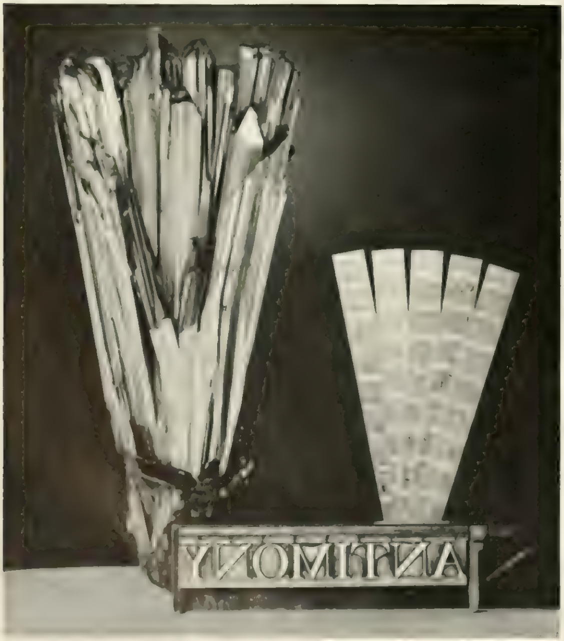
In direct military applications, antimony eclipses all other strategic metals

By Frederick H. Pough

[illegible]

A [illegible] metals published in 1933 said: "In general, antimony may be considered as a [illegible] that will become a substitute for expensive metals rather than be itself replaced." Yet today we find it high on the strategic list and are casting about for substitutes for many of its uses; thus do predictions work out. However, our old sources of antimony had to be replaced by new ones several years before active participation in the war increased our problem. To a certain extent we can thank the Japanese because their control of the trade routes rendered Chinese exports of antimony almost negligible. In about 1928, 90 per cent of the world's antimony came from China, but in 1940 only 15 per cent.

Stibnite crystals *(left)* from the classic—but now exhausted—Japanese deposit. Best known use of this many-purpose metal is in the hardening of lead for type and printer's slugs *(right)*



Antimony was known to the ancients, though not as a metal until about 1450. The origin of its name is uncertain, but a legend we would like to believe ascribes its derivation to a word meaning "anti-monk." According to this myth, one Basil Valentine observed that a dose given to hogs after "purging them heartily" resulted in an improvement in health and a fine fattening. Hence he thought that if it would do so much for hogs, what might it not do for monks? This experiment, alas, was less successful, for the monks died; and thus antimony got its name. The myth could be rationalized by attributing more resistant insides to the hogs, plus an "anti-monk" effect upon their internal parasites.

Antimony is still used in medicine, though the earlier exaggerated ideas of its value no longer hold. At one time it was so widely resorted to, with resultant bad effects, that laws were passed forbidding its use. At that time it was thought that mere contact with the metal was enough, and pills were kept available for use and re-use when the occasion warranted.

Antimony is sometimes found as a native metal, and some fine specimens have come from California. But all of the commercial production (except where it comes as a by-product) is from antimony sulphide or from an oxidized sulphide. The Latin name for antimony is *stibium,* and the mineral sulphide is known as stibnite. Stibnite is a common mineral, found in many lands and occurring in association with many other ore minerals. It is found near the surface, unlike the ores of tin and tungsten, which occur in deep-seated veins. Readers of earlier articles in this strategic metals series will recall that tin and tungsten ores were deposited by hot solutions not far from their original source in the once molten parent rock. They have been exposed only through eons of erosion and weathering. Stibnite and mercury ore (about which we shall speak later), are the exact opposite. They travel long distances from their igneous sources and are deposited near the surface where the waters have cooled sufficiently. This indicates where we must look for the ores. For tin and tungsten we must search in areas which are geologically ancient. But since antimony and mercury are formed near the surface, years of weathering would have long since removed them, so we must look in regions where igneous, perhaps volcanic, activity has been fairly recent. So literally true is this that we can find hot springs which today are depositing stibnite crystals as they cool and evaporate. Usually, geologically ancient regions will have low relief; geologically young regions will have sharp relief, and with recent igneous activity they may have volcanoes, lava flows, hot springs, and all the other phenomena of such eruptions.

Stibnite occurs in sharp brilliant crystals, steely in color and prismatic in shape. Stibnite crystals are rather variable in their development in different localities, and it is usually possible for an expert to tell the source of the specimen from its appearance alone, as is the case with many other minerals. Many widely distributed minerals reach the peak of crystal perfection at a single place: stibnite from the Island of Shikoku, Japan, is an outstanding example. But often this perfection is counterbalanced by limitation in quantity, and the Japanese mines are reported to have long since been exhausted.

Fine stibnite specimens have come from many other localities, the latest item for the collector being clusters of short but very brilliant crystals from Rumania. The crystals are often crooked, even though they are unbroken, for stibnite is the textbook illustration of a curious phenomenon in which a crystal can be made to glide, without breaking, along a plane at right angles to its length. Pressure applied to the middle of a crystal which is supported at both ends will develop a notch at that point and give the crystal, still structurally a unit, the lines of a swayback horse.

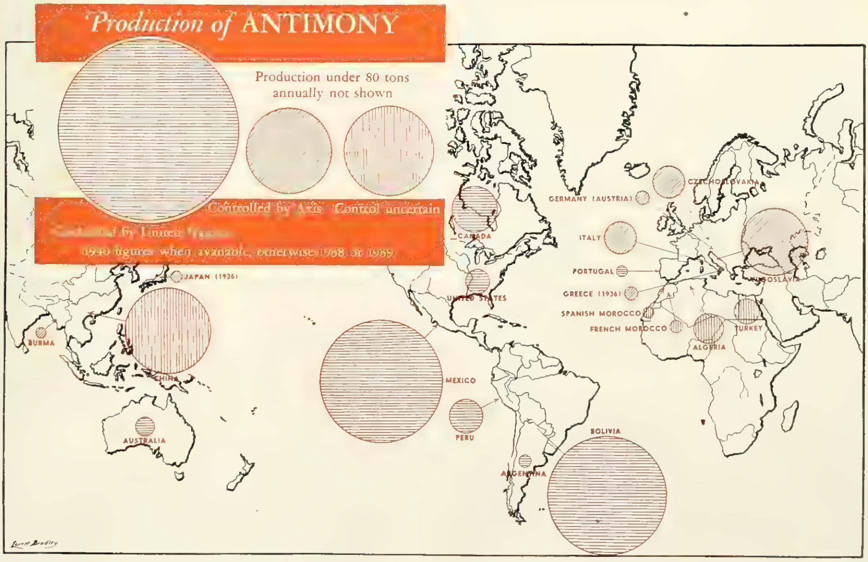
Although the sulphide is the primary ore, a very considerable proportion of our antimony today is derived from ores which, though once sulphides, no longer contain any sulphur.

Removal of the stibnite's sulphur through atmospheric weathering has produced much of the Mexican ore, which is thus in the form of an oxide. When this happens the replacement is often molecule by molecule, with the result that the new oxide mineral preserves the form of the original sulphide crystals. Such chemical substitutions, known as pseudomorphs, in which an earlier crystal form is retained, are fairly common in nature. Many kinds have been described.

In addition to the primary ore of antimony and its oxide, there are a number of other ore minerals, such as silver, copper, and lead minerals, in which antimony is one of the constituents. Some antimony production results from the treatment of these ores, and some antimonial leads smelted from them are used in place of pure lead to which antimony has been added.

Antimony comes on the market in

Continued on page 55


Production of ANTIMONY
Production under 80 tons annually not shown
Controlled by Axis
Control uncertain
Controlled by United Nations
1940 figures when available, otherwise 1938 or 1939
JAPAN (1936)
BURMA
CHINA
AUSTRALIA
CANADA
UNITED STATES
MEXICO
PERU
ARGENTINA
BOLIVIA
GERMANY (AUSTRIA)
CZECHOSLOVAKIA
ITALY
PORTUGAL
GREECE (1936)
SPANISH MOROCCO
FRENCH MOROCCO
ALGERIA
TURKEY
YUGOSLAVIA

CROWNING GLORY of our northern swamplands: the showy lady's-slipper. Its clan (*Cypripedium*) includes many of our finest native orchids, but man has never succeeded in raising any of them from seed

Wild

By CARL T. RAMSEY

A FEW YEARS AGO one could see 15,000 showy lady's-slippers in one New Jersey bog. Today scarcely a vestige remains

[illegible]

RCHID SANCTUARY

Commercial collectors have been methodically stripping the tropical forests of orchids for years, but how about our own orchids—55 species in the state of Vermont alone — which are being wantonly exterminated?

ORCHID lovers all over the world must tremble as they read the war news from Asia and the Pacific Islands. But long before the global war started, the wild orchid was rapidly vanishing from the face of the earth. The lumber, rubber, chicle, coffee, cocoa, and many other tropical enterprises one might mention have taken heavy toll of these rare and beautiful expressions of creative genius on our planet. The cleaning-up process that invariably precedes commercial ventures wrought havoc among the hosts of orchids which embellished primeval forest trees. The names of orchids which occur throughout Malaya, such as *Cypripedium, Dendrobium,* and *Vanda,* invoke joyful pictures that are now associated with destruction.

The enterprising Japs have been busy for over a score of years ripping the last *Phalaenopsis schilleriana* and *P. amabilis* from their arboreal environment. I have seen photographs showing carloads of these rare and beautiful orchids ready for shipment, some of them destined for the salesrooms of Europe and America. It would be interesting to know how many ever survived the journey. Nor are the Japs the sole perpetrators of vandalism. What is one to think when a well-known orchid establishment in Europe sends out its collector to locate the only known hillside where *Cypripedium spicerianum* is found, to make a final collection and then to destroy the station completely by fire to raise the price of the remnants? It is a long, sad story, for the economic factors that determine man's destiny cannot be interfered with for the sake of a mere handful of orchids. No one can tell how many endemic species of orchids were lost when the Panama Canal was dug. Nor can we estimate the orchids' disappearance in the increase of coffee plantations, the oil industry, and other commercial projects that are daily making their inroads in the tropics.

Fortunately the science of growing orchid seedlings and the vogue of creating large hybrids, plus quarantine laws, have put a check on vandalism in the collecting of wild orchids, in some quarters. Nevertheless, the work of destruction is progressing steadily. In the olden days it was customary to secure a lease and then fell many acres of grand forest trees to gather the spoil. Now that a method of raising orchids from seeds in agar flasks has been perfected and many of the more easily grown commercial varieties are established in greenhouses, the wild orchid has had a temporary lease on life. But the whole problem remains one of international consideration. The grower always wants new stock for the breeding of "bigger and better" orchids, so there should be regulations to protect certain rare wild species.

Few flower lovers realize the high degree of specialization which exists in the hundreds of orchid genera. Orchids are globetrotters, and this is doubtless responsible for the delicate adjustment in root, stalk, and flower structure. These aristocrats of the bog, mountainside, and tropical jungle-treetops have become dependent on special combinations of soil, climate, and other factors, which are difficult even for the specialist to duplicate. The inseparable association of certain fungi with their roots alone makes the problem of orchid-growing virtually an impossibility for the amateur. This is strikingly illustrated in our native terrestrial genus *Cypripedium,* or lady's-slipper. Not only do they have to have the association of lime or acid in the soil, but factors of light, shade, and moisture are subtle in determining their well-being. A distinct cleavage exists between the lime and acid soil types.

Up to date it has been impossible to grow the American wild lady's-slipper artificially beyond the protocorm stage. Time and again I have seen well-meaning people wanting to transplant the lady's-slipper from its native haunts to their stiff garden soil.

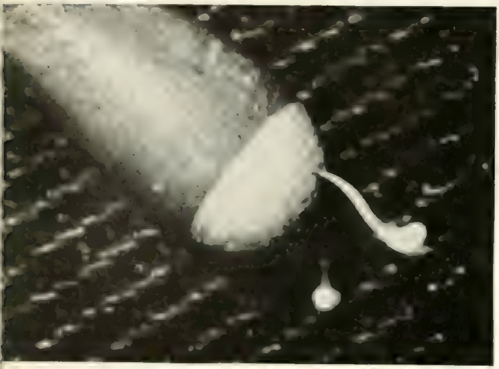
THE PINK LADY'S-SLIPPER thrives in evergreen groves and on dry slopes—if man does not deny its right to live

THE RARE WHITE LADY'S-SLIPPER is among our daintiest; care could preserve it, from New York to Minnesota

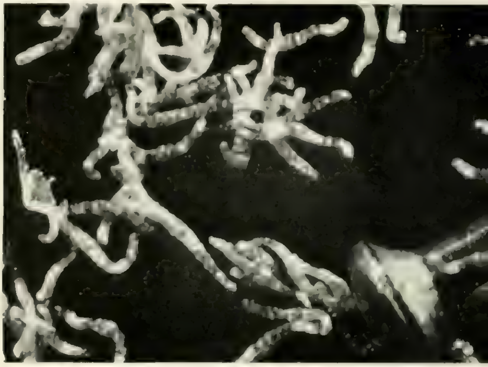
Photos by C. T. Ramsey

(*Above*) ELEGANCE AND GRACE mark the yellow lady's slippers rising on tall stalks from wide leafy bases

A CLOSER VIEW shows the balloon-like lips, burnished gold in color and smoothly rounded as if ready to burst



SMALL in comparison with a match head, the pollen masses of the yellow-fringed orchid contain the fertilizing element for many thousand tiny seeds



HAIR-LIKE SEEDS of the pink lady's-slipper. Man has failed to grow them, but with Nature's mysterious care they develop into glorious plants. Note pinhead

BEAUTIFUL *vanda caerulea* of the East. One collector delivers 1000 plants each Christmas, to sell at eight cents each. Thus the forests lose them to the ash can

(*Right*) A perfect specimen of *Cypripedium fairieanum*

This is a natural instinct, for we all are worshippers of beauty. Alas, such attempts invariably prove fatal. We have had sporadic wild flower conservation propaganda in the public schools, and doubtless some good has accrued. Maybe it is the elders who need admonition and education more than our youth. Every country outing during the blooming period of the lady's-slippers produces casualties. They are an exciting sight. Indeed it can readily be understood how in earlier days this excitement was translated into the superstition that the roots of these plants were useful as medicine. To see the showy lady's slipper in its native haunt is indeed a panacea. But to see these same plants massed together by the hundreds as if they were in a concentration camp is enough to make any flower lover sick.

If the evidence of the last score of years in Vermont is any criterion, anyone can predict the ultimate fate of the *Cypripedium reginae* in these environs. In the score or more places where one could see from a dozen to hundreds of these handsome plants, not a vestige of their glory is to be found today.

Fortunately many of our wild orchids are inconspicuous and live in secluded spots where few excursionists ever venture. But even these are threatened with extinction by the cutting of timber, the inroads of agriculture, the commercial sphagnum or peat moss traffic, and the draining and filling in of bogs as a result of the encroachment of civilization about metropolitan areas and rural communities.

It was this swan song of the orchid that took us from New York to Vermont eight years ago. I had been experimenting with the terrestrial wild orchid for a long time prior to this. My experiments have continued for about a score of years. Initially I had intended to grow wild orchid seedlings to offset the rapid decimation.

The casual observer, peeping into "Swampacres" at Dorset, might see little to pique his curiosity at certain times of the year. It is in truth a bogland nestling among the alders, willows, larches, maples, and snowy birches, a half mile from the highway. Here embowered in wild tranquillity, with the hilltops encircling the horizon, we found an ideal sanctuary for wild birds and native orchids. Geologically the Dorset Valley is included in the great marble basin extending from New York Bay to the St. Lawrence. In the middle of the valley where we are situated, there is a happy combination of lime and acid soil, for which the glacier is responsible. The adjoining hillsides are practically all outcroppings of limestone, while from farther north the ice sheet gathered acid debris and dumped it in our valley in a series of acid drumlins or moraine mounds. This produced an ideal situation for the various types of orchids at "Swampacres." Indeed, it would be difficult to find a place better suited for an outdoor laboratory in what is probably the first experiment of its kind in this country. Flower lovers may express surprise when told that over 55 species of orchids grow wild in the State of Vermont; and over two-thirds of these occur within the confines of our eight-acre sanctuary.

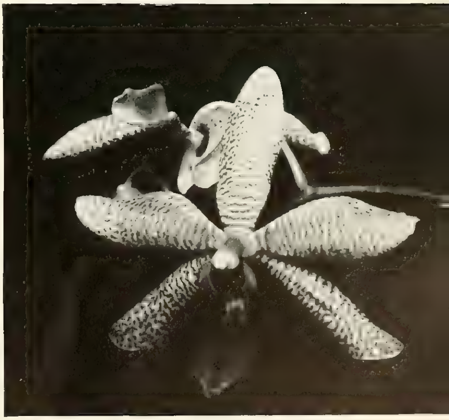
Animal enemies

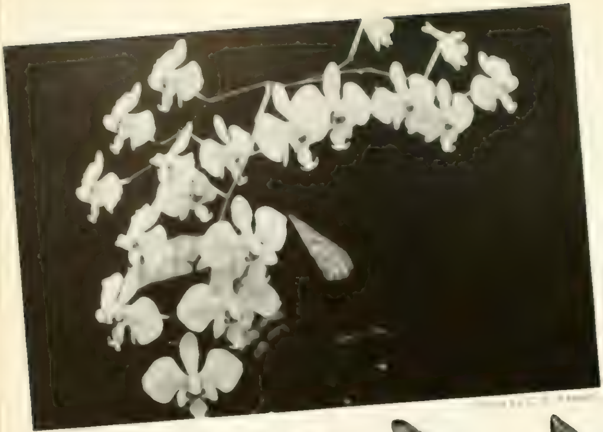
Before the various species of orchids could be accommodated, "Swampacres" had to undergo a heroic process of renovation. Moreover, I soon discovered that I had local enemies, such as the mole, rabbit, skunk, and woodchuck, which developed into serious offenders. My concern was not so much for the native species—they could be replaced—but for those imported for observation and study from Europe, Asia, Canada, Alaska, California, Mexico, and

ONE OF THE "BUTTERFLY ORCHIDS" (genus *Oncidium*). This group comes from tropical America and is well known for its bright attractive colors and peculiar form

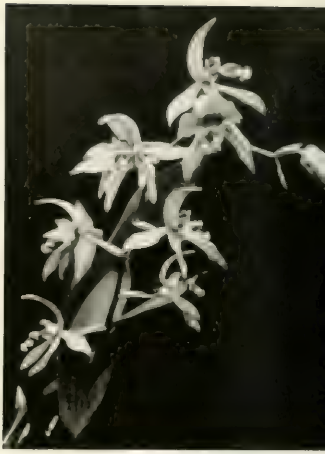
Photos by F. H. Pough

AN EXOTIC HYBRID, of the sort greenhouse-growers raise readily from seed. Conservationists have had little success with our dwindling native orchids

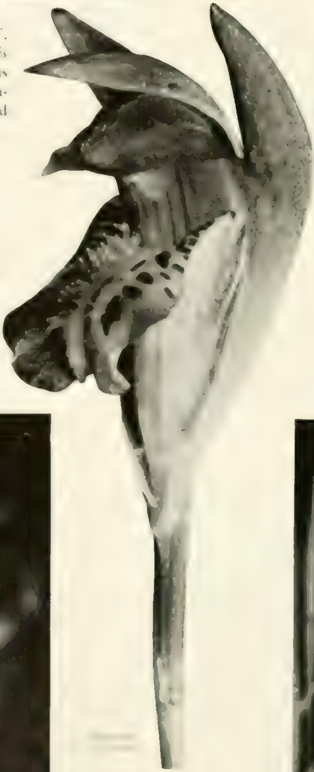




MEANING LITERALLY "moth-like", the genus of which *Phalaenopsis schilleriana* is a member contains some of the showiest and most beautiful of all spray orchids. (India and Malaya)

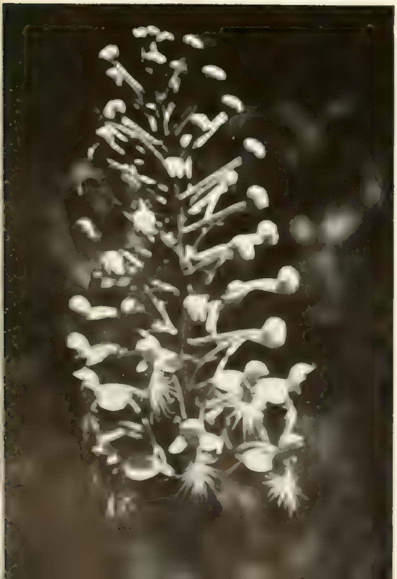


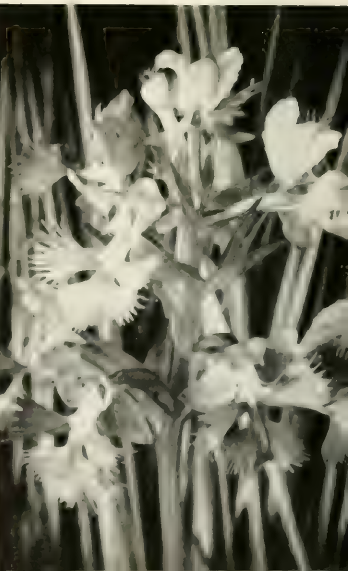
THE GREEN ORCHID from Borneo, *Coelogyne pandurata*, is one of the handsomest of its tree-dwelling clan



THE SHOWIEST ORANGE-COLORED ORCHID native to our northern territory: the yellow-fringed orchid *(below)*

(*Below*) A GIANT sometimes five feet high, the large purple-fringed orchid is the biggest of its group





(*Above*) JAPAN has its only cousin. Let us preserve the beautiful dragon's mouth (*Arethusa bulbosa*)

Japan. It was trying indeed to find a newly introduced species dug up by some curious skunk the morning after I had planted it. And in spite of the soil advantages, it was necessary to shift the plants to different quarters of the bog in a process of trial and error. In many cases I failed to know the proper requirements, and this lack of knowledge invariably resulted in the death of the plant. The problem of protection from rodents was solved by the use of three-eighth-inch wire mesh baskets, which could be easily packed and repacked and placed according to the requirements of light and moisture.

A score of years of experimentation with wild orchid plants has convinced me of a few very definite things. While I have been successful in observing and recording necessary information in pursuance of my studies of the form and structure of orchids, the project for conserving anything but the native species may be set down as a failure. With few exceptions imported plants linger with peevishness for one, two, or even a dozen years, but they show no degree of vigor or inclination to flower. Apparently it is impossible to supply certain imported orchids with the necessary environmental conditions. I might mention some of these as they behaved at "Swampacres." The California lady's-slippers *Cypripedium californicum* and *C. fasciculatum* flowered for the first year, and *C. montanum* bloomed two years. From that time on they merely produced feeble shoots devoid of bloom. Obviously the climate of Vermont is too harsh for them. So too, Japanese lady's-slippers *(C. japonicum, C. debile,* and *C. macranthum)* flowered two years and from that time appeared only anemically. The rare white lady's-slipper, *C. candidum,* which came from a New Jersey bog, has flourished somewhat better. For over fifteen years this charming orchid has been producing flowers, and the crown which originally had but four shoots, has now increased to fifteen.

The most lamentable feature of importation, say from California, is the amputation of roots, ostensibly to save postage. I have seen a crown of plants having nine to a dozen leads, with roots clipped to between six and nine inches to fit a box 5 x 11 x 6 inches deep, with packing material taking up at least a third of the space. Normally the crater which such a plant would occupy would be at least from five to six feet in diameter and about eighteen inches deep. *C. montanum* is a deciduous orchid, and the energy of previous years is of necessity stored in the roots. As I unpacked the box, my thoughts flew to the Sierras by a lake shore where the air was heavy with white azalea bloom and where hard by grew just such a plant, mingling its own delightful scent. The plant in question I venture to say, was at least 100 or more years old and it sold for the ridiculous price of five dollars.

Vanda and vandalism

The horticultural hybrid with its Asiatic forebears has won for itself high place in commercial markets and public demand. It is the rare wild varieties that need conservation. Not so long ago I talked with a collector who had been in India and Burma on a special mission to collect certain wild species. His tale of *Vanda caerulea* was revealing. Who would compare any horticultural hybrid with so lovely a wild species as *V. caerulea?* Like our showy lady's-slipper, *V. caerulea* in Asia is approaching extinction. Strangely enough, many of these wild rarities have had superficial attention among conservationists. It is now necessary, however, for collectors to have a permit before they can go into the Burmese forests. *Cypripedium insigne* cannot be collected at all, but *V. caerulea,* which blooms in the fall of the year, commands a ready market in Calcutta and other centers where the flowers are sought by foreigners. One local native has a standing contract to deliver a thousand or more *V. caerulea* plants each Christmas. These plants are sold for eight cents each. After the holidays when they have flowered, their destiny is the foreigners' ash heap or garbage can. Normally these plants sell in the United States for from seven to ten dollars a plant.

In America there is a crying need for a few wild orchid sanctuaries. To my knowledge this matter has had little or no attention. It would be comparatively easy to acquire certain areas where the showy lady's-slipper, *Calypso,* and certain of the *Habenaria,* such as the white-fringed and large purple-fringed orchids, are growing wild. These sanctuaries would automatically afford ideal haunts for the woodcock, certain warblers, and other birds that are associated with swampy country.

I know of glaring cases of ruthlessness in New Jersey and Vermont, indeed also in other parts of the country. I recall one bog in New Jersey where it was possible to see between 15,000 and 20,000 showy lady's-slippers each June. In the two-score years that I have known this bog, the pageant of *C. reginae* has dwindled annually until today there is little or nothing left of it. Apparently there is nothing to be done about it; such beauty simply cannot survive. The peat moss traffic, the nerve medicine business, and countless other encroachments form a juggernaut of destruction that no mere flower lover can stop. What is one to think of a prominent nurseryman who sends out half a dozen men in a truck to gather white-fringed orchids in two-bushel bags as if they were tubers of a common potato? When the woman who owned the property wanted to know what the nurseryman was doing, he pertly announced that it was none of her business. This same firm offered to buy showy lady's-slipper plants at two dollars a hundred. At a retail price of twenty-five or fifty cents each, one can easily figure the net income of such an enterprise. The age of these plants ranges anywhere from twenty-five years to a century or more. It should be repeated that up to the present science has not been able to produce these wildlings in the agar flask, so that the decimation will continue until some drastic measures or an educational sanity will put a stop to it.

We are going to discover the real significance of orchids someday. Meanwhile, what are we going to do about it? It is a desperate situation that will need more than a few effete laws of protection. The work of systematic botanists is still progressing, but we know comparatively little of the natural history of these fascinating flowers, and the mummies in the herbarium sheets deserve more than a mere label. Their living presence in a wild bog is a precious

Continued on page 56

HOW CHIEF MOUN

By H. E. Vokes

CHIEF MOUNTAIN known to the Indians as "The Old Chief," rises to 9000 feet above sea level. Viewed from the west it appears as a block of ancient limestone 1500 feet thick, on the border of Glacier National Park

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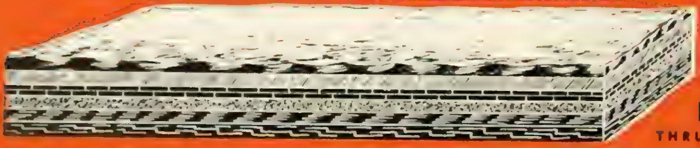
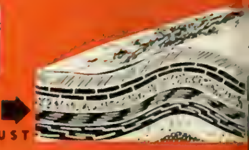
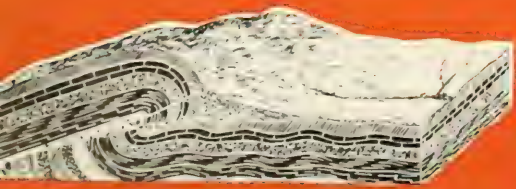


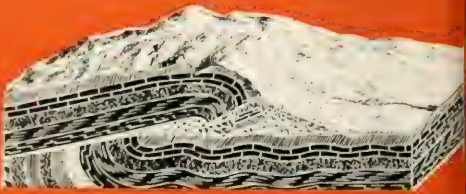
1 First, flat beds of limestone and shale were formed under a shallow sea



2 —700 million years, la



The beds to the west slid up and over those to the east



5 —sandwiching younger layers of rock between older ones

IN WAS MADE

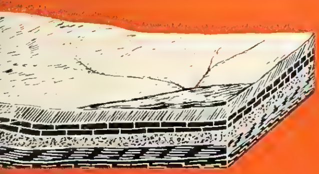
The extraordinary story of a mountain that was pushed uphill and—after millions of years—became the sentinel of the red man's hunting grounds

PROUDLY, square and strong like a great warrior, "The Old Chief" stands forth in massive grandeur overlooking more than 100 miles of plain to the east. You have traveled over the prairie as on a great sea, westward over the plains of Montana toward the Lewis Range of Glacier National Park, when this landmark looms up ahead, a large lonely bastion guarding the even more gigantic wall behind.

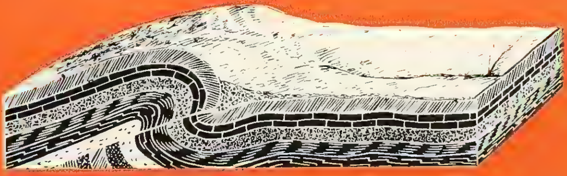
Some twenty-odd years ago there was a great earthquake in central China. The jarring motion of the quake caused great cliffs of wind-blown sand (loess) to break loose. Devastating avalanches swept over hundreds of tiny villages, burying more than 100,000 helpless villagers. Ever since, this region has been known to the Chinese as "the land where the mountains walked." Chief Mountain (as we of today have modified its ancient Indian name) did not walk to its present position—it was pushed! And it was pushed uphill! For Chief Mountain is no ordinary mountain; it is unusual in its present position, in its nature, in its structure, and in the history of its origin and development.

Events of two widely separated periods in geologic history are recorded in the rocks exposed in Chief Mountain.

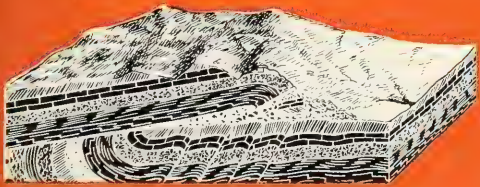
The oldest layers were deposited hundreds of millions of years ago—how many, we do not know exactly, but 700 to 800 million seems to be a safe assumption. During those most ancient days shallow seas covered the region that we now know as Mon-



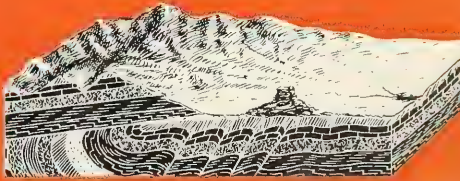
t pressure folded them



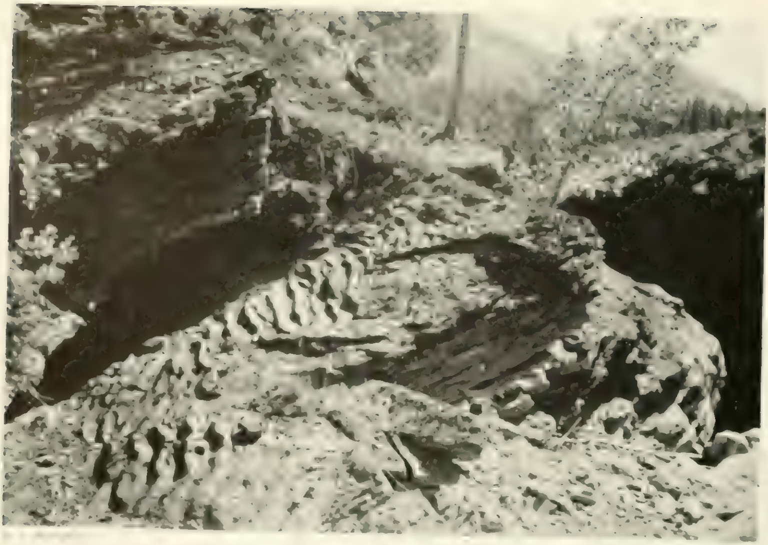
3 Instead of crumbling, the limestone resisted, and the layers broke



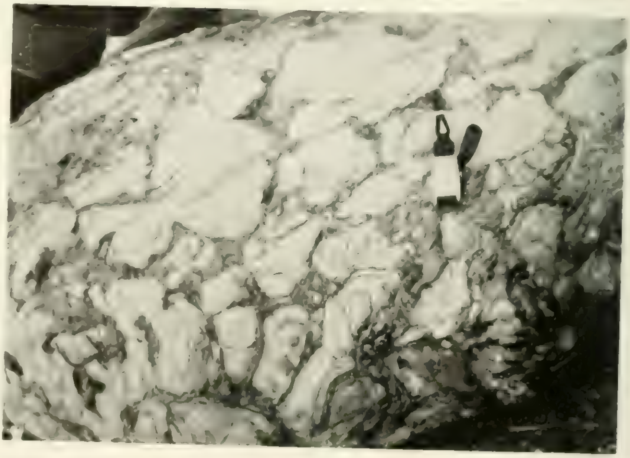
6 Eight miles of rock were pushed at least 15 miles



7 Then ice carved away all but one block—Chief Mountain



Ripple marks visible today in the sandstone of Chief Mountain *(above)* tell that these ancient rocks were laid down in a shallow sea



Lime-secreting seaweed of a type now extinct formed the limestone block at right, a type readily recognizable to anyone who visits this landmark and examines the evidence of its strange history

ta and adjacent parts of Alberta. This was in those very early times when animals were either rare or had not as yet learned to build shells or other hard parts that might be preserved as fossils. But plant life was abundant; the sea bottoms were covered with masses of strange lime-secreting seaweeds whose remains built up great thicknesses of limestone. These limestones alternate with beds of shale that are characteristically ripple-marked and mud-cracked, showing that they were all deposited in a shallow sea. After many, many years the sea withdrew, leaving behind it a series of these limestones and shales which are seven to eight miles thick!

During the ensuing interval of about 700 million years, deposits were probably laid down, but now they either are buried under younger beds or have been eroded away.

The record is picked up again about 80 million years ago. The rocks laid down then consist of sands and muds deposited in a sea in which animal life was abundant. These were the seas in which roamed the ammonites with their chambered shells, while on the shores the equally bizarre dinosaurs dominated and terrorized the tiny ancestral mammals.

But this sea was short-lived in comparison with that older one. For it was forced to withdraw as the land commenced to groan in the pangs of the birth of a great mountain area. The first Rocky Mountains were beginning to develop. Tremendous pressures began to compress and squeeze the strata. The evidence shows that these pressures were exerted from the west, squeezing the beds against the great rock mass which underlies the Great Plains. In many places the beds crumpled, forming highly folded mountains. In western Montana, the thick limestones were strong and resisted the squeezing for a long time, but finally the pressures became too great. Instead of crumpling, the strata broke, the beds to the west sliding up and over those to the east. The entire seven or eight miles of limestone and shale were pushed not only up and over the same beds to the east of the break but also over all the sandstones and shales of the younger series.

Just how far they were pushed we do not know, but we can see that it was at least fifteen miles. And when they finally came to rest there was a belt of land at least fifteen miles wide and almost 100 miles long in which the rock sequence included not only the normal succession of older beds overlain by younger, but also younger beds in turn overridden by older ones—a gigantic sandwich of thick limestones with a filling of sandstones and shales.

But erosion soon began to gnaw away at the sandwich, eating the uppermost crust first. Rivers developed canyons across its surface, deeply dissecting it. And then, about a million years ago the climate became colder, glaciers formed on the higher elevations and began to move down the valleys, deepening and widening them as they went. As it became colder and colder, the glaciers moved farther down the valleys and out onto the plains, where they joined the great ice sheet which was moving down across the plains from northern Canada.

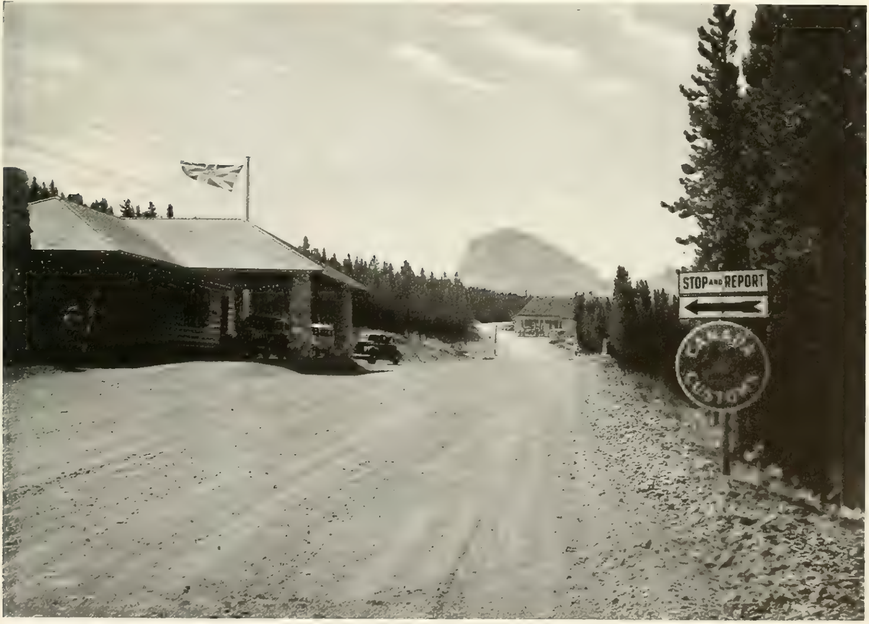
When a warm climate returned and the ice melted, the upper layer of the rock sandwich had been deeply carved. Thus was formed the glorious scenery of Glacier National Park. Near the edge the crust had been completely cut through to the filling of younger sediments. At one place, however, a great block of the older limestones stood forth on the plains, completely separated from the main mass behind. This block is today called Chief Mountain.

Chief Mountain is indeed no ordinary mountain. Rising more than 9000 feet above sea level it is a single block of ancient limestone, 1500 feet thick, sitting on a series of younger sandstones and shales, over which it has been thrust from a place far to the west where the limestones were originally laid down.

A square, towering monument to the forces within the earth which made it, the Old Chief stands, facing the plains, an imposing sentinel still guarding the hunting grounds of the red men who gave him his name.

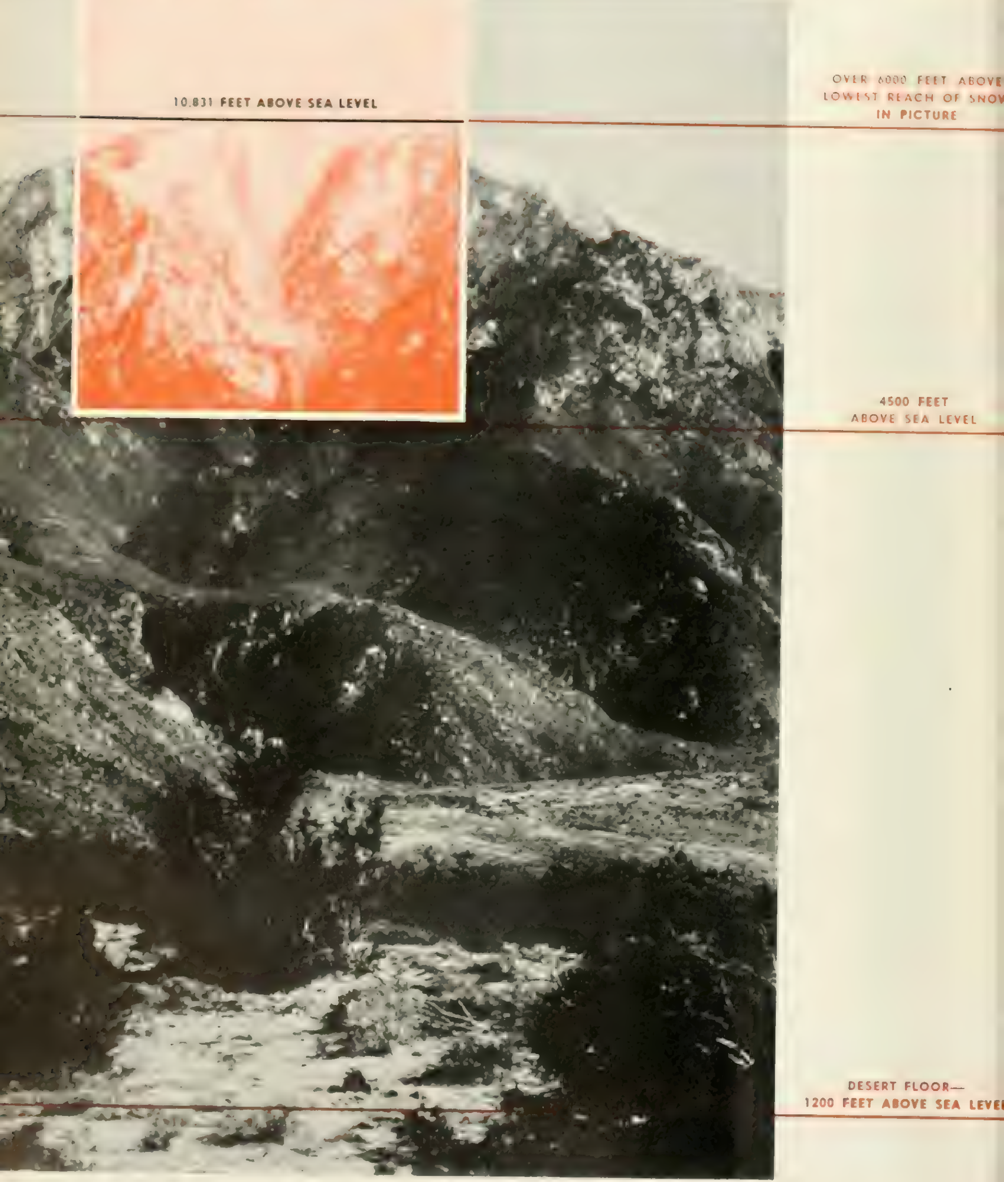
LIKE A PROMONTORY on the sea. Chief Mountain is a landmark to the traveler traversing the broad plains east of the Rockies in northern Montana—a sentinel over the most peaceful border in the world

Photo by the author



SAN JACINTO—Our Greates

[illegible]


10,831 FEET ABOVE SEA LEVEL
OVER 6000 FEET ABOVE
LOWEST REACH OF SNOW
IN PICTURE
4500 FEET
ABOVE SEA LEVEL
DESERT FLOOR—
1200 FEET ABOVE SEA LEVE

Precipice

By Tom Hughes

The sheared-off and gouged-out north face of Mt. San Jacinto presents the greatest precipice in the nation. No other of our cliffs approaches its skyward reach. When the desert air is especially clear, the beholder half expects the far cornice to begin toppling over.

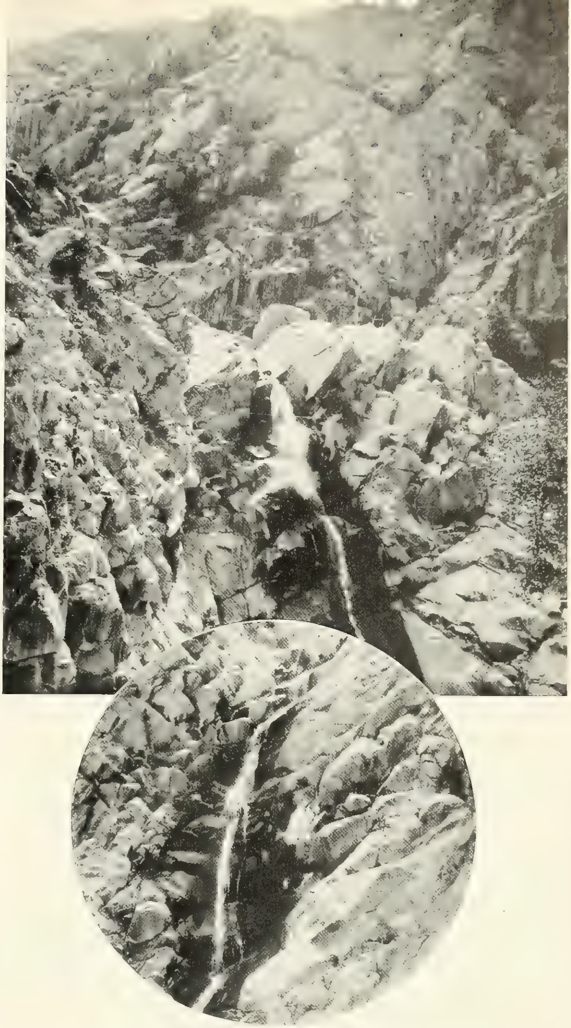
The precipice rises alongside highway 60-70-99, 100 miles east of Los Angeles and ten miles west of Palm Springs.

For the naturalist, San Jacinto is unique among districts in the United States, perhaps in the world. Five, if not six, life zones are exhibited on the mountain. These, using the Western classification, range from fan palm of Lower Sonoran to Hudsonian limber pine. Some authorities consider the summit as penetrating the Arctic-Alpine, thus making San Jacinto the southernmost mountain in the United States to exhibit this zone. Theory aside, there is an ancient limber pine reaching out toward the very topmost boulder.

Our great north scarp, however, offers meager evidence of the upper zones. A squat, tapered-bole cedar clings here and there while, deep in a chasm, some névé pocket may be fringed with little asters that recall the edelweiss. You could traverse the scarp all day long and meet no animal inhabitant. In the nighttime you might hear the scuttle of a lizard among the pebbles, and dawn might disclose an eagle wheeling high. Other birds have little call to visit the rocky desolation, even in passage, and none but flying fish could navigate the upper cataracts of Snow Creek.

This stream, of three confluent head brooks, gathers somewhere in the higher walls, sinks in its granite bed, gushes out, and hurls itself to a thousand destructions down the precipice. Geographers have called its east fork the wildest stream in North America.

In all our panoramic land there can be no vaster view than the one from atop this monument. A rim of ocean, the gaunt Panamints of Death Valley, a snowy peak in Nevada. Off toward Old Mexico a turquoise sparkles on the breast of the desert—remnant of an ancient dried-up sea, it still offers its cup of water to the sun.



Snow Creek plunges to a thousand destructions down a precipice whose towering grandeur the upraised camera can scarcely encompass. The eastern of the three brooks forming it has been called the wildest stream in North America

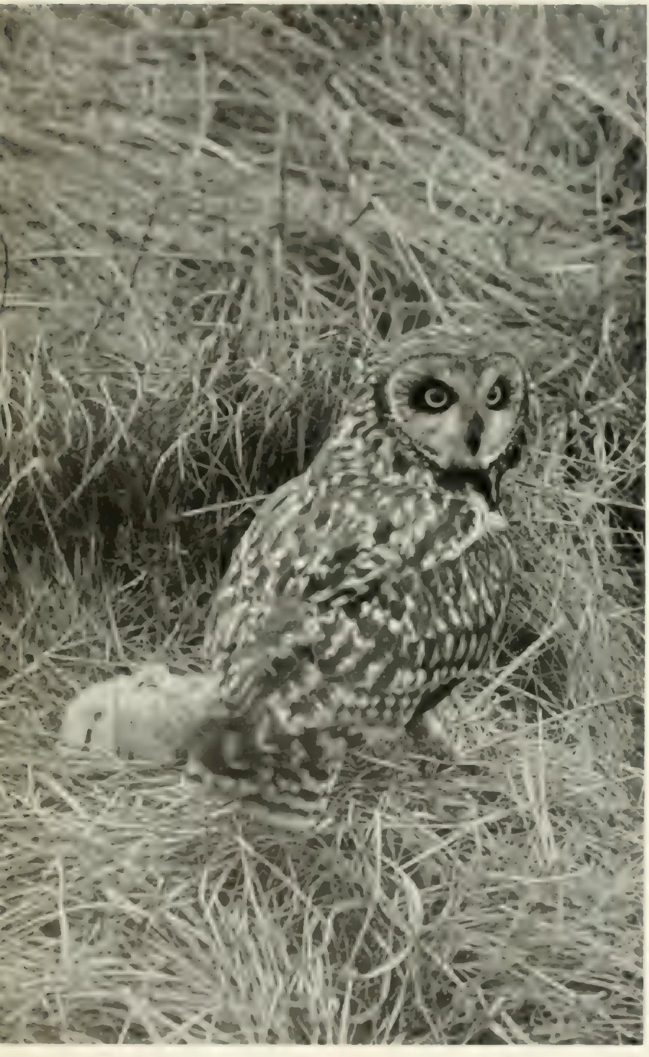
Gradually you gather courage to look down. Taking a firm hold, you peer over the brink. Everything appears to have slid away. A mile below, in a haze of twilight, you make out the granite debris, and pinnacles that somehow stood against the debacle; but their foundations are lost to view in the purple shadows of the desert floor, still another mile down. Language fails now. One word that may come, on the wind that rises out of the abyss, is "cataclysmic."

You may toss a stone over; but you will see nothing, hear nothing. No echo comes up from the void.

So stands the peak of Saint Hyacinth, first in abrupt height, first in architectural *élan,* and first in those qualities that fire the mountain lover's heart with ecstasy.

The short-eared OWL

The high, windswept moors of the Scottish borderland are the scene of a photographic expedition to study the rarest of the owls that breed in the British Isles



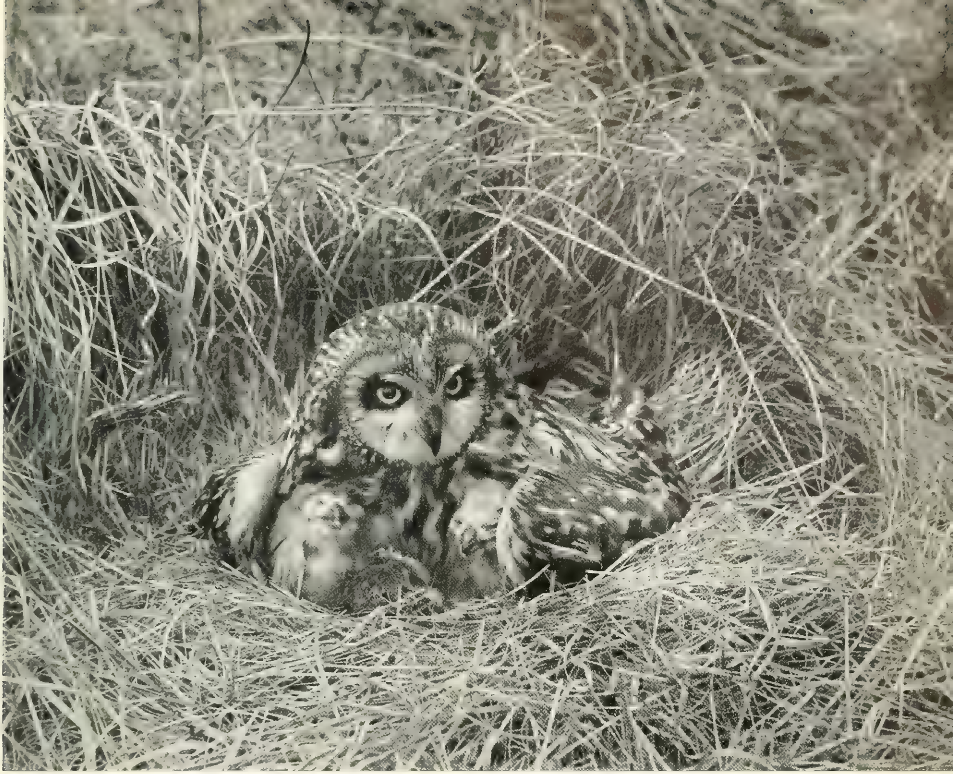
By G. K. Yeates

With photographs by the author
[illegible]

April today has given of her best. The showers, the forbidding skies which even when most promising had yet always threatened, and above all the wind have been absent. The elements indeed have striven, for a brief period at least, to give real meaning to Browning's much quoted words about the joys of an English April. Today, for the first time since we invaded their lonely solitude, the Border moors have smiled, and the burns and cascades glistened in the sunshine beneath a cloudless sky. The dried dead moorland grass that has hitherto been lashed level with the ground by the fury of the wind, and the scattered pine clumps that have swayed restless before its force, have both alike been at peace, without a rustle. All day the curlews have greeted the new promise with the lovely music of their breeding trill, and the golden plovers in less elaborate display have piped their satisfaction at the change that at long last has brought spring to their moorland home. This evening the blackcocks have sparred with more than usual determination, as well they might, for has not today brought to their tourney-ground the first gray hen of the year?

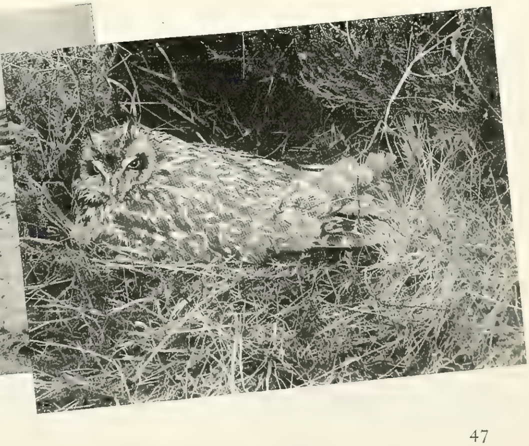
The voles in the deep grasses have everywhere scampered away as we disturbed their runs. And after the voles have come the short-eared owls *(Asio f. flammeus)*. Yesterday, a day of wind and rain, few living things had moved. The moors seemed dead and not a le-

(Left) A MERE EIGHT FEET from the camera and unafraid. Unlike most owls, this nearly cosmopolitan bird is active in daytime as well as at night



THE PHOTOGRAPHER'S HIDE *(below)* overlooks the moorland home of the short-eared owl. Where voles, or meadow mice, abound, this avian expert quarters the ground with a graceful buoyancy unrivaled by any of its kind. In years when voles are scarce, the owl is equally so

(Above) PUSHING their way to light from the comfort of mother's wings. When preening, re-arranging, and feeding her young, Mother Owl's head seems detached and capable of turning in a full circle. *(Below)* When angry or alarmed, Mother Owl shows her ear tufts

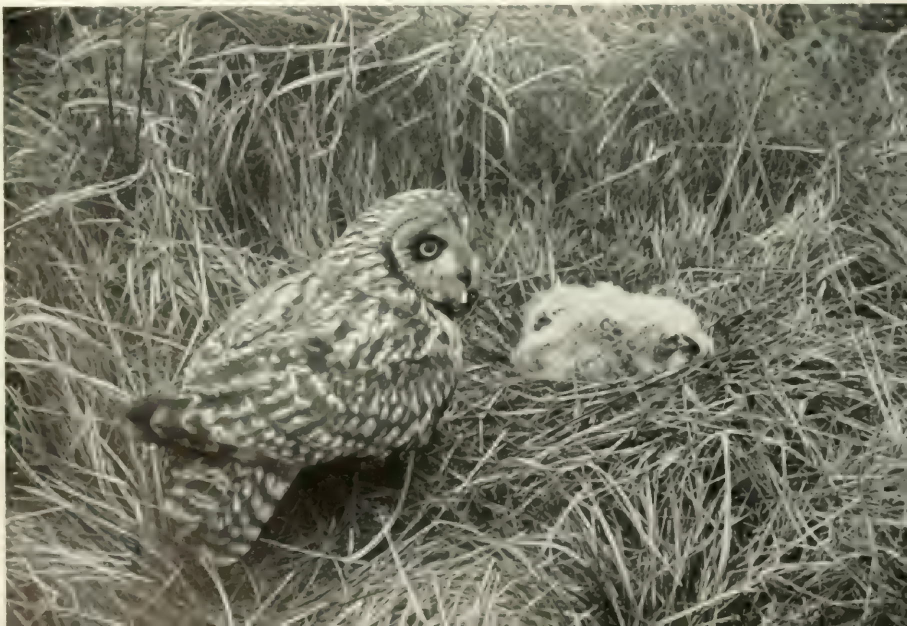


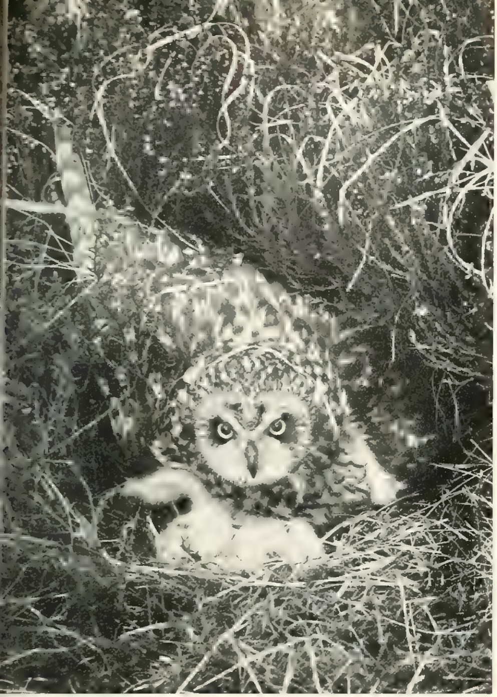
[illegible] These aerial masters have given of their best, and the superb ease of their silent flight has dominated [illegible] gest in its flight the power which is implied in the [illegible] headlong speed that is prompted by the peregrine's stoop; its performance may not even be as impressive [illegible] of its kind. Its long brown dappled wings carry it [illegible] of many of its bird neighbors on those moors look [illegible] neath it, the quick plunge to earth that lands the bird all askew, its wings outstretched over the heather, are one and all the practiced skill of a peer- [illegible] they have been flying today, slipping and twisting, [illegible] now looking back beneath them, taking their relentless toll of the mischievous rodents that would willingly eat like locusts the pasture of these sheep [illegible]

All this morning I was in the confines of my "hide," [illegible] her ten days ago, with the unwitting help of her lord. For he it was we had been watching at his evening hunting. With eyes that grew weary through prolonged watching through the glasses, we had fol- [illegible] spirals, his plunges, his momentary hovers, all had given us hope that he would soon kill food for his [illegible] in the long moor grass on her white eggs, was no [illegible] prescribed. Eastward an old fence turned him in his tracks; to the north his hunting followed the line of a newly cut drainage ditch. He rarely overshot the [illegible] to resume his work. All this area now lay before our gaze. It seemed certain that in those many square yards of dried moorland grass his mate sat close upon her white eggs awaiting the meal which, now that it was evening, it was her lord's task to kill for her. And so we waited and watched, watched till our eyes were nigh on bursting with the strain. How often too he cheated us into false hopes! Time and again he wheeled on his course, to plunge back into the grass. Yet time and again he rose without that little brown lump in his talons which we eagerly looked to see—the vole that would send him speeding to his lady. Once he rose and in bee-line flight sped over the moor to his boundary. Had he food? Would he plunge in and give away his secret? It was yet another false alarm. A neighbor had violated his terri-

(Below) **Back to her family** on wings so silent that not the slightest rustle can be heard eight feet away

(Right) **The piercing glare** of a mother on guard. Six eggs changed into downy chicks during the observations





tory, and without ceremony was driven off. And so back to his wavy hunting, that patient and remorseless quartering of the ground by which he polices those vole-ridden moors.

Quite suddenly he killed. A quick plunge, a quick grab, and the deed was done. For a moment he looked around him, wings outstretched over the grass. Never once did he glance beneath him. Doubtless his talons told him their tale of success. When he rose, how different was his flight! Gone was that slow quartering; gone too the sideslips and the twists and turns. Straight as a die he sped over the moor, to plunge in again on the slopes of the slight ridge which was his eastern boundary. To our joy another owl rose beside him, a mere five yards away, and there we found a nest of six eggs.

And thus it was that I have spent the still loveliness of this April day a mere eight feet from the brooding owl. For a week now I have daily sat with her and watched her white eggs change into downy chicks. For three days we accustomed her to the hide, an easy task, for she had but little fear of man and refused to jump until the hand was about to touch her. Thus our comings and goings disturbed her little, and she grew used to the canvass tent that rose slowly from the grass beside her.

All this time her eggs have been hatching, not all within a short space of one another like most birds, but haphazardly as is the way with owls. On April 17th she had two chicks, and when she rose from the nest she tossed them high into the air like two pieces of fluff. Two days later three downy balls were scattered to the wind as she flew off. On the 20th yet another had emerged; on the next day one more, but the sixth came to life on the 25th—a full eight days after its eldest brother and with a correspondingly poor chance of survival, I imagine.

Development indeed has been remarkably slow. True, the two helpless tiny chicks which the old bird tossed to the four winds when we first found her have grown markedly in size. They swell almost visibly overnight. Their white down has become a dirty gray. But there has been no apparent simultaneous increase in strength. Until yesterday, exactly a week after hatching, they were still blind. They show no signs of real life, seeming satisfied to lie half dead in the nest, inanimate balls of fluff.

Nor has the female owl encouraged them. The kindliest of mothers, she has on returning to her duty been content to brood them, and activity of any sort has been conspicuous for its absence. Her arrival, indeed, has been the high spot of each of my periods of observation. It is an uncannily silent performance. One moment the nest is untenanted; at the next the hen bird is standing by its side, staring straight at the hide with those beautiful pale yellow eyes. There is no warning. Those long wings beat so silently that not the slightest rustle penetrates to the ear a mere eight feet away. Only the talons, as they grip the grass, give any clue of her coming. Then with a slow crouching walk she shuffles onto the chicks, and broods. Thereafter she sleeps in the sun or crouches out of the wind, a charming study in dappled browns.

As the spirit moves her, she rearranges the young beneath her, pulling her head back and squinting awkwardly down her breast. Occasionally she preens herself, and strange are some of her positions. Her head seems detached from her body and capable of turning round in a full circle. Yet she has done little else. Only once have I seen her feed them. This morning on my arrival there was a vole in the nest. As usual she returned within a few minutes, but the dead vole was ignored, until an hour or so later two chicks appeared under her wings and pushed their heads into the light. She now seized the prey and tearing it into tiny pieces fed the chicks in turn. The young satisfied, she opened her wide mouth and in a trice the remainder of the vole vanished within, and without so much as a visible gulp she settled down to sleep again.

In the quiet peace of this evening the cock has been busy at his display. All day long he has scoured the hillside for voles. Now with appetite sated he rises high in the sky and with steadily beating wings holds the same position in the upper air. A low, far-carrying *boo-boo-boo* note resounds at frequent intervals. Unexpected dives break the monotony of this performance. On a sudden the wings are clapped together beneath the body and the bird takes 200 feet of twilight in the twinkling of an eye. From this plunge he sweeps back into his original position and once more marks time, until once again the spirit moves him to plunge earthwards in that ecstatic dive. When I left him the light was fading and only his incessant note told me that this bird of both day and night was still at his duty post.

Natural History

ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

COLOR PROCESS. BLACK AND WHITE. BEN DAY. LINE

[illegible]

Filter For Your Color Shots

By CHARLES H. COLES

[illegible]

C[illegible] made

Color film can't think, so you'll have to do that job for it. The use of corrective [illegible] in getting good Kodachromes. It will surprise many camera fans that there are more than a dozen corrective filters available to adjust the color response of Kodachrome and Kodacolor.

The [illegible] filters

[illegible] that is color balanced expressly for daylight may be used for filming indoors under artificial illumination. Photoflood light is very deficient in blue compared to daylight, so the changeover filter emphasizes what little blue there is. This filter is blue in color, therefore. It is #80 in the Wratten Filter series. It will convert all Kodachrome Regular and Kodacolor film for [illegible] Photoflood [illegible] here's a warning. The speed of the film is reduced to one-third its normal value. So, be sure you have plenty of light.

The second changeover filter, as you may have guessed, changes the response of Type A Kodachrome so that it may be used in daylight instead of the artificial light for which it is designed. This indoor film has an exaggerated sensitivity to blue light so as to record properly the small amount of this color given off by artificial illumination. To reduce this excessive blue sensitivity when the film is used outdoors, a salmon-colored filter, a Wratten #85, is slipped over the lens.

The fact that this #85 filter converts Type A Kodachrome to daylight use with no loss in speed as compared to the Regular Kodachrome makes it very popular with the amateur. He keeps his camera loaded with Type A film and is ready to shoot outdoors or in by merely slipping on or off the filter. The disadvantage of this arrangement, to my mind, is that all the outdoor shots have to be made through a filter,—and no filter, no matter how good, improves the definition of a picture.

The ultra-violet filters

Although color film does a pretty good job of reproducing things that you can see, you may be surprised to find that it also reproduces things that you can't see. Invisible ultra-violet light, that sun-burning element in sunshine, will record on Kodachrome as a blue haze. This becomes especially serious where ultra-violet is abundant, as in high altitudes. To reduce this excessive blueness, filters that absorb [illegible] have been manufactured.

The so-called Haze Filter, or Wratten #1, is designed to absorb strongly the ultra-violet without affecting the visible light. Placed over the lens of a color camera, it will reduce slightly the bluishness of distant scenes. On the whole, its effect is very slight. No change in the lens aperture is therefore required.

A filter with a stronger ultra-violet absorption is the 2A filter. This is a faint yellow filter and has a much more positive effect upon Kodachrome than might be expected from its delicate color. It is definitely useful to improve the warmth of scenes taken where no sunshine falls. Pictures made in the shade and on cloudy days will benefit from its use. No increase of exposure is required.

The color correction filters

These are faintly tinted filters used to correct slight deficiencies in the color of the light so that the tones will appear true in the final picture.

As an example, suppose a Kodachrome is to be made of a habitat group in a museum. These groups are illuminated usually by ordinary incandescent lamps which operate at a color temperature of about 2800 K. At this temperature light possesses a strong yellow color with very little blue. Kodachrome A, the indoor color film for miniature cameras, is corrected to the color temperature of the photoflood lamp, but this operates at 3450° K. and gives a much bluer light. To accentuate the small amount of blue in the habitat group and prevent the picture from turning out too yellow, a bluish filter—CC 6—is used over the lens, which raises the apparent color temperature of the lights to that to which the film is balanced. The color of the final picture thus appears to be in correct balance when we look at it.

The bluish color correction filters, the CC 3, 4, 5, and 6, raise the apparent color temperature of the lights by which the picture is taken. If by any chance the lights happen to be too blue, the yellowish color correction filters, the CC-13, 14, 15, are pressed into service. These filters are useful to overcome the bluish color of photoflash lamps and make colors taken by this light record truer on the film. Each higher number in the color correction series represents a deeper color in the filter.

Deficiencies in certain colors call for the use of the complementary color correction filters. CC 23, 24, and 25 are lemon yellow in color to emphasize that color in the final picture. Magenta colored filters, CC 33, 34, 35, will make the camera view life through rose-colored glasses. CC 43, 44, and 45 are green filters to strengthen the film's response to green.

Thus it is evident that, although Kodachrome and Kodacolor have no brains with which to decide what color is wanted in the final picture, the photographer has ample opportunity to use his in the selection of one or more of the various filters, so that the completed picture will show the colors as he saw them, not as the film would have reacted to them.

Agfa Ansco
PLENACHROME FILM
MADE IN U.S.A.

The right camera angle is part of the secret of every good picture. Notice how rider and lariat are sharp against the sky. But it's even more important to use the right film—Agfa Ansco Film. It is guaranteed: "*Pictures that satisfy or a new roll free!*" For sparkling outdoor pictures, insist on Agfa Ansco Plenachrome. Its extra margin of quality minimizes many exposure errors! ***Agfa Ansco, Binghamton, N. Y. 100 Years of Service to American Photography.***

YOUR NEW BOOKS

THE SILVERSMITH IN MEXICO ● CANADA'S DOMINION IN THE NORTH
AMERICAN FRESH-WATER FISHES ● DIAMONDS ● EDENS

CANADA MOVES NORTH

by Richard Finnie

Macmillan, $3.50

ON [illegible] Arctic Circle, and the Northwest Territories west [illegible] themselves are building a thriving dominion in the North, not on an imaginary icecap but in a land where all snow quite prosaically melts at 32 degrees F. and summer temperatures rise to 70, 80, and 90 degrees.

If you flew from San Diego to Oslo by the shortest route, you would want to stop halfway at Bathn Island. From New York to Manila your most direct course would carry you across the Arctic Coast of Canada. Thus the section of the Western Hemisphere farthest from the beaten track, breaks through a veil of ignorance and confusion as the future aerial crossroads of the world.

The man who knows Canada's Northland is Richard Finnie. The book that gives the best account of its human and economic meaning to the world is *Canada Moves North*. Finnie was born in Dawson City and since 1924 has traveled far and wide in Arctic Canada. He is a scrupulously accurate observer and in his story uses no miracles to lift Cinderella from obscurity. If the land has not yet reached its proper destiny, he offers proof that man's own ignorance and mismanagement are to blame. His discussion of the problems faced by the Indians and Eskimos is a valuable contribution, full of good judgment.

This book of lasting value will appeal to everyone interested in human geography. No home library with aspirations should be without it.

[illegible]

PLANT FAMILIES HOW TO KNOW THEM

by H. E. Jaques

Pictured-Key Nature Books, Mt. Pleasant, Iowa, $2.50 (Spiral binding, $1.50)

FOR a serious beginner in the study of botany this is a very helpful manual since it contains illustrated keys for determining the families of nearly all of the members of the entire plant kingdom. It thus avoids the usual objection to popular works on mushrooms, or flowers, or trees, or any other group of plants—that they contain such a small proportion of the entire group. This little book has the completeness of an unabridged dictionary as compared with a small desk dictionary.

Every step in the keys is illustrated by good clear line-drawings, and this has made it possible to reduce the text to the minimum. At the close of the book is a phylogenetic list of the families of plants, and an index and pictured glossary.

The author is Professor of Biology in Iowa Wesleyan College, and the book has evidently come out of his actual teaching experience.

Clyde Fisher

REPRESENTATIVE NORTH AMERICAN FRESH-WATER FISHES

by John T. Nichols

Illustrated by Andrew Janson
Macmillan, $1.25

THE publishers of this volume indicate that it is intended for anglers or anyone else interested and then go on to say: "We have asked John T. Nichols, Curator of Recent Fishes, American Museum of Natural History, to prepare the text for this brief introduction to the Science of Fishes (Ichthyology)." Following this expression of intent we find that there are 60 plates, one species to a page, each faced by a page of text. Of these illustrations, some of which are very good and all satisfactory, 29 are in color.

The author's approach to the subject is perhaps best described in the publisher's own words, as follows: "Mr. Nichols has packed a great variety of data about fishes into a limited space. We hope that this glimpse into this fascinating science of fishes will lead you to wider investigations and open up a new field of interest." With this latitude Mr. Nichols has set forth, in one-page briefs, data on each of the 60 species. Through these he has contrived to weave, in true Nicholesque fashion, remarks on phylogeny, life history, and habits, often also indicating what is unknown.

It occurs to the reviewer that this is just the kind of a book that should fall into the hands of a boy in his teens. The meditations of such a natuaralist as Nichols are necessarily stimulating, especially to one in formative years.

To attempt to criticize small details would be carping indeed on such a disarmingly composed book. The fact that the fishes are not arranged in any conventional order is presumably a concession to the maintenance of the conversational nature of the sketches. The Index is excellent.

Nichols' comments on 60 species of fishes, with good pictures of as many, for a dollar and a quarter, is a buy at any time.

C. M. Breder, Jr.

THE ART OF THE SILVERSMITH IN MEXICO, 1519-1936 —(2 vols.)

by Lawrence Anderson

Oxford University Press
Limited Edition, $30.00

THE Art of the Silversmith in Mexico is a work of profound scholarship. It is perhaps the first basic work of true scholarship on one of the important arts of Mexico. Perhaps only the great work of Baxter approaches the exhaustive quality of Major Anderson's study.

The fascinating thing about this work is how the native population of Mexico took over many of the Spanish arts and skills and from them created their own. The silversmith's art was notable, and one of the glories of colonial Mexico was the beautiful artistry of this craft which became more than a craft, in fact a true art. The Spaniards knew keenly all the values of high craftsmanship, and one of the most interesting features of Major Anderson's study is how their skillful legislation and control allowed them to maintain a high, noble standard of work. The carefully documented text and the superb illustrations bring out these features in a striking and imposing way.

The greatest possible credit is due Major Anderson, for despite his arduous and exacting duties as the executive of a large American business he found time not only to collect specimens, but also to pursue a tortuous trail through early Spanish documentation. There was no one before him to blaze the way. He and his assistants had to start from the beginning and assimilate the material out of which this imposing work is the result. This book was expensive to produce and it is not within the reach of everyone; however, the student and the artist by going to a library can take this superb work and consult its manifold examples and documents. In these days of growing interest in Latin

America it is refreshing to find a path so well defined on which to build a lasting structure of knowledge on which true understanding depends. In *The Art of the Silversmith in Mexico* Major Anderson deals not only with the field of art but also with the fields of law and history and affords as well important data for anthropological and sociological study.

GEORGE C. VAILLANT.

VANISHING EDEN

- - - - - - - by Martin Birnbaum

Rudge, $5.00

MARTIN BIRNBAUM should be a familiar name to the readers of NATURAL HISTORY Magazine since his brief, illuminating travel narratives have appeared in its pages at frequent intervals. He is a world-wide traveler who seeks out the unspoiled havens where aboriginal life survives—"Edens" he calls them, because they are free from the shallow commercialism tourists leave in their wake.

The eleven chapters of the book range through Central America, Asia, Polynesia, and Africa. There is a vivid word picture of the Sahara Desert—the best we have ever read, a touching account of life in Bali, an intimate view of Yünnanfu and the Burma Road, and informing notes on Maya-land in Guatemala and Yucatan. NATURAL HISTORY readers and visitors to the Akeley African Hall will read with interest the descriptions of the Mount Mikeno country, Africa, where the body of Akeley lies in its lonely grave. Again they will enjoy the sketch of Patrick Lowell Putnam and his jungle home in the Ituri country of the upper Congo area. The names of many other familiar explorers and writers met by the way will thrill the reader as the author meets them in out-of-the-way places. The numerous photographs are of unusual excellence.

CLARK WISSLER.

NEEDLE TO THE NORTH

- - - - - - by Arthur C. Twomey (with Nigel Herrick)

Houghton Mifflin, $3.50

THE east side of Hudson Bay is singularly bleak and wind-swept, cold in winter, inhospitable to man even for northern Canada. Sixty miles or so off its coast lie the Belcher Islands, a series of more-or-less parallel, barren, rocky ridges, trending east of north. About an equal distance from the shore into the interior of Ungava is a fresh-water lake known to be inhabited by seals that had never been collected and described prior to the Carnegie Museum of Pittsburgh expedition in 1938, of which this is the narrative.

In the late winter of 1937-38, A. C. Twomey and J. K. Doutt of the Pittsburgh Museum went north, reached the lake from the coast by dog team and collected specimens of the seal, crossed to the Belcher Islands by the same means just before the ice jam between islands and mainland broke, and remained there until August, observing the return and nesting of the few land birds and many seafowl of which these islands are the summer home.

The book tells of the wild northern terrain crossed, of constant struggle against the inclement climate for which it is noted. In much detail it goes into the personalities of the few white men, the Ungava Indians, and the Eskimos of coast and islands on whose co-operation the expedition depended. Aside from being an interesting story of adventure, it is a record of value from several aspects. Always in the background there is the tragic picture of how inevitably the white man's blessings have upset the delicate adjustment between these northern people and their hard environment, and are proving false blessings for them in the long run.

The scientific records of northern beasts and birds—objective of the expedition—will be found published elsewhere. But scattered through this narrative are many references of interest to the naturalist. Such are the accounts of an old bull walrus bellowing the alarm from a rocky islet where his unsuspecting herd had been sunning and sleeping, until the last one had escaped into the water, and of the mating dance of the purple sandpiper.

J. T. N.

FIRE IN THE EARTH

- by James Remington McCarthy

Harper, $2.50

AN interestingly-written, popular account of diamonds, *Fire in the Earth* tries to tell everything of general interest about this unique mineral. The author has consulted many works and gives a fine bibliography. In addition, it is clear that he has taken advantage of the opportunity to talk to people in the trade and has thus attained a very practical approach to such things as color, cutting, and flaws.

We read in succession about the origin of the diamond, localities for diamonds, mining methods, the history of the De Beers interests, the arbitrary trading methods of that company, the cutting of diamonds, and the changes in the centers brought about by the war. There are chapters on the changing modes in diamond jewelry and cutting, famous pieces, and legends and superstitions associated with diamonds. A concluding chapter speaks of the industrial uses of diamonds—a recent discovery of the popular writers, though in some senses, actually as old as diamond cutting itself.

Interspersed between the practical chapters of instruction are short, italicized sections upon famous stones, like the filling in a layer cake. In them we re-read the familiar legends of some of the larger and better-known stones.

Fire in the Earth is a practical book with a practical approach and should be of great assistance to the potential purchaser of a diamond in that it shows

Continued on page 54

VANISHING EDEN — Know and understand the countries in today's headlines. A richly illustrated travel book including uncut versions of essays appearing in "Natural History Magazine"

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Curator of Recent Fishes
American Museum of Natural History

EVERYONE interested in fishes will want this authoritative, pocket-sized guide with colored and black and white pictures, and descriptions of sixty common fresh-water fish. It tells their size, habitat, gives special characteristics and unusual items about each fish, common and technical names. It is a brief introduction to Ichthyology. The book is enclosed in a handy slip case. $1.25

MACMILLAN
60 FIFTH AVE., NEW YORK, N. Y.

[illegible] mentioned by name in the section on the [illegible].

F. H. [illegible]

ENJOYMENT OF SCIENCE

by Jonathan Norton Leonard

Doubleday, Doran, $3.50

“SCIENCE understood is usually interesting. Science not understood is almost always dull.” With this consideration, the author has attempted, in this one volume, [illegible] all of the principal sciences. They are grouped under three general classifications: the “life sciences” including biology, with all of its branches, [illegible], entomology, microbiology, and ecology; the “thing sciences” including geology, oceanography, meteorology, and astronomy; the “laws of the universe” including chemistry, physics, mathematics, and logic. In most cases there is a short description of the field covered by the science, and for each there is an annotated bibliography of the better works available to the average reader. In general these are the best parts of the book and should be most valuable to those who desire to browse intelligently through the sciences.

These [illegible] interspersed with digressions,” as they are called, on such subjects as bibliographies, reader morale, books and libraries, make up the book. While [illegible] it is one which I personally enjoyed reading.

H. E. [illegible]

STRANGE NEW WORLD

by Alec Chisholm

Angus & Robertson, [illegible] Castlereagh St.
Sydney, Australia

STRANGE NEW WORLD tells of experiences in Australia between 1839 and 1844.

Alec Chisholm's keen interest in the work of John Gould led him to England during 1938 in search of new material relating to Gould's life and work. He was unsuccessful in his quest but Gould's two great-grandsons had the diary and field notebook of John Gilbert, ornithologist and collector [illegible] Gould in Australia and later of the German explorer Ludwig Leichardt. These papers were sent to England by Leichardt after Gilbert's death. No mention had ever [illegible] since Gilbert's death until they fell into Mr. Chisholm's hands.

The [illegible] of the diary is [illegible] and since Gilbert's entries were made with great regularity and considerable [illegible] of the expeditions and the personalities of the [illegible] of the parties is presented to the reader.

The first part of the book is devoted to Gilbert's early work of exploring and collecting birds in Tasmania and Western Australia, while the second part describes Leichardt's expedition from Brisbane to Port Essington near Darwin, during which Gilbert so tragically lost his life at the hands of Australian blackfellows.

Mr. Chisholm admires Gilbert greatly, and is strongly prejudiced against Leichardt, whom he considers incompetent as a bushman and totally lacking in the qualities of leadership. Nevertheless, though the trip from Brisbane to Port Essington took many months longer than had been calculated and entailed much suffering and hardship for the entire party, it brought lasting honor to Ludwig Leichardt.

YVONNE A. RAVEN

A REPORT ON EXPERIMENTS WITH COLCHICINE By Laymen Scientists During 1942

by O. J. Eigsti and Barbara Tenney

University of Oklahoma Press, 35¢

COLCHICINE is a chemical which causes hereditary changes in plants. If applied to the growing portion of a plant it has a power to produce variations which are transmitted to following generations. Thus it promises to be a useful tool in the development of better types of plants. This 32-page booklet summarizes experimentation with this chemical during the past two years and explains to interested laymen the manner in which it is possible to participate in the Co-operative Research Project under the guidance of the University of Oklahoma.

Close-To-Nature CANVAS HOUSE

[illegible]

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GOOD MEDICINE LODGE
Bigfork, Montana

NAME THAT ANIMAL

by Ernest C. Driver

[illegible] Prospect Street, Northampton,
Mass. [illegible]

THE author, who is Associate Professor of Zoology at Smith College, sets forth in the Preface that the purpose of this book is to provide the reader with a practical key to the identification of land and fresh-water animals. It covers more ground than any single volume of the kind known to this reviewer, every group from the one-celled animals (Protozoa) to the mammals being treated. Along with the Protozoa a small section is devoted to diatoms, desmids, and other small algae—plants that are found associated with microscopic animals.

We are reminded that the land and fresh-water animals include members of all the major groups or phyla of animals except the brachiopods, ctenophores, and echinoderms, which live exclusively in salt water. Abundant line-drawings facilitate the use of the keys. These constitute a simple and clear method of defining terms and characters used in the keys, and make it possible to keep the text brief. Following the key to each group is an excellent list of up-to-date, more complete, systematic works for those who wish to go further.

The type of key used, Doctor Driver says, “is one that he has found, after much experimentation with students and long-suffering friends, to be easiest to operate.” The book is a field manual for all except very small forms, and the keys are not based upon characters revealed only by dissection.

Beginners and nonprofessional zoologists, we believe, will welcome so inclusive a field book as this in one volume of just a little more than 500 pages—a veritable *multum in parvo*.

CLYDE FISHER

CONE-BEARING TREES OF THE PACIFIC COAST

by Nathan A. Bowers

Whittlesey House, $2.50

EVERY Easterner who visits the western states must be impressed with the conifers or cone-bearing trees of the region, and many are interested to know their names. Here we have the largest tree in the world, the tallest tree in America, and one or two of the rarest ones of our country. And what a variety of conifers there are in the west! Seventeen kinds of pines, seven firs, five spruces, two hemlocks, three larches, seven cypresses, five junipers, two sequoias, and several others. And here is a complete popular manual for one's side coat-pocket that makes their identification easy. It contains an abundance of fine photographic illustrations, excellent drawings of needles and cones, and three kinds of keys, namely, the Needle Key, the Elevation Key, and the Geographical Key.

CLYDE FISHER

ANTIMONY

Continued from page 33

three forms, the melted sulphide, often known as crude antimony, the concentrated ore, and refined antimony. Regulus, an old word still in use for antimony metal, comes from an ancient reference to its affinity for gold in the smelting of a mixed ore. "Star antimony" is a variety whose spangled surface is thought to indicate especial purity, though it actually is caused by the manner of crystallization under a cap of still molten slag. The refining of antimony is not difficult. Regular blast furnace treatment reduces the oxides, and the sulphides are purified by heating the ore with iron which makes antimony metal and an iron sulphide. The compounds of antimony are very volatile, however, and to avoid undue loss in the treatment, precautions must be taken to catch the escaping gaseous portions.

Antimony has more direct military applications than any other of the strategic metals, and a higher proportion of the annual consumption goes into military uses. They are very important uses too, and the most important is allied to the principal civilian use. That is in the hardening of lead. From a military standpoint it is used to harden the cores of bullets and shrapnel balls, and G. A. Roush, in his *Strategic Mineral Supplies,* also says that the sulphide is used in the bursting charges of shrapnel to form a dense white smoke making easy observation of the place of burst. Some sulphide is used in the percussion caps of rifle and artillery cartridges, and it has been said that the natural mineral is better than an artificial sulphide for this purpose.

The principal uses of antimony in the hardening of lead are the same in peace as in war. Battery plates probably account for the greatest consumption. Type metal is another great consumer. Castings of pure antimony are sometimes made, and antimonial lead castings were used in some auto trims. Not only is antimony valuable in rendering the lead harder, but it is also useful in preventing the shrinkage which lead undergoes in cooling, a factor of some importance in the rapid casting of type. The content of antimony varies according to the use. Linotype letters once used and then remelted contain less antimony than loose type which is set and reset for many printings. Antimony is used in bearings, and is often a substitute for tin.

All of these metallurgical uses—battery plates, cable coverings, and type metals—destroy very little of the metal, so that a large amount of the annual antimony supply is in the form of reclaimed metal. Some uses, however, remove it permanently from the market. The commonest example of this sort and one that affects everyone, is in the heads and on the striking surface of safety matches. An antimony sulphide is used here. White enamels and white paint pigments use some of the oxides. An early method of vulcanizing rubber used a complex sulphide which broke down to a simpler red sulphide and free sulphur, which did the vulcanizing. This practice has almost disappeared, but the red coloration of rubber that it started is still with us.

Britannia metal, pewter, Babbitt's metal and other white metal alloys also use some antimony. We shall probably notice a reduction in their use. Pewter will no longer be a popular item in the department stores, but we shall certainly not be as embarrassed by this wartime problem as we should have been a few years ago. In 1931 a smelter for Mexican ores was opened in Texas, and today the Mexican and Bolivian production fill most of our needs. Some American production is also to be noted, and a guarantee of prices higher than ten or twelve cents a pound (now it is fifteen cents) for a period of two years or so, would undoubtedly bring about more domestic mining. No one wants to gamble on a plant which may take a year to build, with no assurance that at the end of that time he will have a market that will repay the cost of development and exploitation.

You may not be able to get a new battery when you need one, you may not be able to get a new pewter bowl, and your candlesticks and coffin plates may be of some other substance, because of the extra need for good hard shrapnel and easily visible anti-aircraft bursts, but thanks to recent developments we needn't worry too much about our antimony supplies. The Texas smelter commenced operation in 1931, so we cannot attribute our present status entirely to recent war developments, but rather to part of long range planning to exploit nearer sources of supply. However, at the same time, we can hold out no hope for an Axis shortage of antimony, though the transportation problem should give them a headache.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct Answers on page 56

1. Fifty-five species of wild orchids grow in
(a) Hawaii
(b) Bermuda
(c) Vermont

2. What strategic metal is vital in the lead plates of your storage battery and in the type from which this page was printed?

3. The most beautiful Navaho blankets were woven before the white man came to America.
True......... False.........

4. The plant which gives Arizona its state flower attains a height of 40 feet and is threatened with extermination. What is it?

5. Rabbits never swim.
True......... False.........

Do you remember the answers to these questions from last month's NATURAL HISTORY?

6. What country in the Western Hemisphere produces the most diamonds?

7. How do some modern laundries mark their customers' clothes without using any visible writing?

8. An anachronism is something out of place with regard to time. What is an anachorism?

9. What is an elver?

10. What mother in the animal kingdom suckles a baby fifty feet long?

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ITS SESSIONS THIS SUMMER

WYOMING

[illegible] a family vacation. Restricted. Write—
PATON RANCH, Shell, Wyo.

Answers to Questions on page 55

1. [illegible] See page [illegible].
2. [illegible]. See page 12.
3. [illegible] See page 31.
4. [illegible] See page [illegible].
5. False. The marsh rabbit, found [illegible] See page 21.
6. [illegible] the [illegible] Western Hemisphere. See May issue, page 2[illegible].
7. By using inks that are invisible until they are flooded with ultraviolet light in a darkened room. See May issue, page 29[illegible].
8. An anachorism is something geographically out of place. See May issue, page 250.
9. An elver is a young eel. See May issue, page 257.
10. The blue whale, or sulphur bottom. See May issue, page 2[illegible].

★

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NATURAL HISTORY Magazine

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WILD ORCHID SANCTUARY

[illegible]

surface. They have persisted through the vicissitudes of time, from possibly [illegible] million years before the coming of man.

With the vanishing of wild orchids from the American countryside we have seen also the disappearance of many of our rarer birds. One must live in the country to realize how the woodcock, veery, and warbler have dwindled from year to year in their swampy environments. It should be a criminal offense to offer any American lady's-slipper for sale. The commercial traffic in these rarities should be stopped at once. The few haunts in which they survive should be located at the earliest possible date so that the survivors can persist in Federal and State sanctuaries. Otherwise nature lovers of the coming generation will miss the fascination and joy that is associated with the living reality.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Summer, 1942

SUNDAYS over the Mutual Broadcasting System (WOR) from 9:30 to 10:00 A. M.

This Wonderful World. Quiz program, with young people answering questions on nature subjects.

•

WEDNESDAYS, June 3, and June 17, over WNYC from 3:30 to 3:45 P. M.

Know Your Museum

•

FRIDAYS over the Columbia Broadcasting System from 4:15 to 4:30 P. M.

Exploring Space. A new dramatic series about astronomy and its practical applications.

URGENT

The Museum Library is in need of back issues of NATURAL HISTORY, particularly the first four issues for 1942. Copies sent to the Librarian, The American Museum of Natural History, New York, will be greatly appreciated.

September

NATURAL HISTORY

1942

Nickel · Talking Drums of Africa · Quinine and the War

Raymond B. Fosdick: A Malarial Invasion · Migration

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Descriptions and illustrations (many in color) of sixty representative North American fresh water fishes. An invaluable aid in identifying most of the species which the angler may encounter; pocket size. By the Curator of Recent Fishes, American Museum of Natural History.

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CHARLES FRANCIS PRE

LETTERS

SIRS:

. . . Your Magazine, NATURAL HISTORY, gives me far more pleasure than any other magazine I have ever received.

Allentown, Pa. CONRAD W. BAKER.

* * *

SIRS:

I expect to be drafted into the United States Army in the near future. However, I would like my copies of NATURAL HISTORY sent to my present address until further notice. . . .

If I am not in a position to renew my membership next February, this will not signify lack of interest in the splendid work of our museum.

It seems to me that in these times, when civilian activities are limited in one way or another—and may be more greatly limited in the future—all those who do not take an active part in the war will have an excellent opportunity to broaden their interests. This is where your Magazine and Museum come in.

I trust no government will take action to limit the activities of such educational institutions as the American Museum. Someone, many persons rather, will have to keep the torch of truth aflame whilst other fires are burning in other lands. . . .

New York, N. Y. CHARLES PHILLIPS.

* * *

SIRS:

To a person whose duties keep him well tied down a long distance from New York, your excellent magazine is an important contact with the live program of the Museum. Your April number was terrific. Even an anthropologist, and particularly one who is interested in museum matters, can get tremendously excited over those photographs of animals, plus maps and just enough carefully worded text to make one wish he could hop on the next train and take a look at the groups themselves in the Museum.

Browning, Mont. JOHN C. EWERS.

* * *

SIRS:

. . . I have enjoyed every issue of this beautiful magazine during the past year—each number has seemed to excel the previous issue—truly a joy to lovers of the beautiful.

St. Louis, Mo. ANNA M. SINGER.

* * *

SIRS:

I have just received my first issue of your magazine and cannot refrain from expressing to you a deep feeling of remorse. This feeling stems from the pleasure I derived in reading the contents of NATURAL HISTORY and the realization of what I have missed these many years.

Here, I have been a neighbor of the magazine for some time, and yet I never knew it. I will admit that I had been under fire from some of my patients, but I resisted their influence up till now.

I want to tell you how glad I am to be a subscriber now, and that henceforth NATURAL HISTORY will occupy an important place in my waiting room.

GABRIEL R. VOGELSON, D.D.S.
New York City, N. Y.

* * *

SIRS:

I have always enjoyed being a member of the Museum. Somehow that makes me

NOTICE

Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

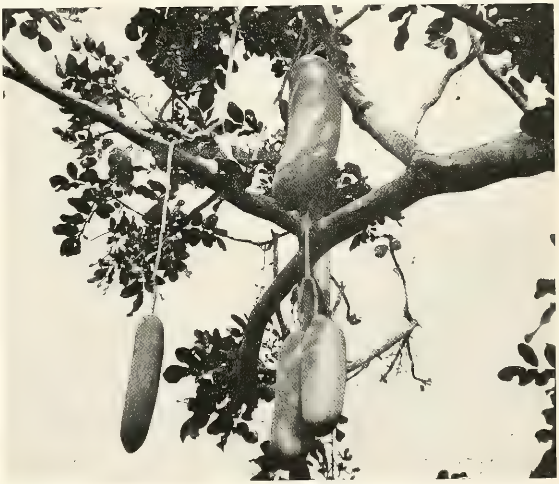
A TREE THAT SEEMS TO GROW SAUSAGES

By DAVID FRANKLIN MARTIN

The first time you look at it you would swear that it had produced a crop of sausages. But actually the strange shaped objects it bears are the natural fruit of the so-called Sausage Tree and are used in the making of medicine by the natives of the Mozambique section of Africa. The tree is held in high esteem by the natives, who consider it a sacred tree.

Few of these trees *(Kigelia pinnata)* are to be found outside the section of Africa where they grow naturally. Some have been transplanted, but for the most part they do not seem to do well and seldom increase with the same rapidity as some other foreign trees and plants.

The one shown in the accompanying illustration is to be found on a little island adjacent to the Venetian Causeway which connects Miami with Miami Beach in Florida, where it attracts much attention from visitors from other parts of the country.



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$100 in U. S. War Savings Bonds for the third highest number.

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Rules

1. This contest is limited to NATURAL HISTORY Magazine subscribers in the United States. Employees of the American Museum of Natural History and their families, and professional magazine solicitors, are not eligible.

2. To qualify for the contest, you must send in at least three new subscriptions. Each contestant sending in five new subscriptions will receive a one-year renewal of NATURAL HISTORY free.

3. Payment of $3.00 must accompany each subscription.

4. Renewals will not be considered new subscriptions.

5. In case of ties, the tying contestants will be required to submit a letter of not more than 50 words setting forth the merits of NATURAL HISTORY Magazine, and the award will be made to the contestant submitting the best letter.

6. All subscriptions must be received on or before October 10, 1942, or bear the postmark of that date. Winners will be announced in the November issue of NATURAL HISTORY.

7. Envelopes containing subscription forms may be procured from the Membership Secretary.

Contest closes October 10th.

Address all communications to:

Membership Secretary, The American Museum of Natural History,
New York, N. Y.

feel that although I am busy teaching and do not have much time for research I am doing something to further its work. Besides my students enjoy reading my copies of NATURAL HISTORY. Perhaps some day I can take a group of my pupils to the Museum for firsthand information.

Richmond, Va. [illegible]

• • •

SIRS:

May I take this opportunity to compliment you on the magazine of our organization. Aside from its interesting contents, it is a really beautiful example of printing art. . . .

I find it a comfort in these days of strain to turn to interesting accounts of what happened to this old planet and its inhabitants during the millions of years of the past. . . .

CHARLES LAWSON ROBINSON

New York, N. Y.

• • •

SIRS:

I want to tell you how much Mrs. Maris, our two sons and I enjoyed our visit to the Museum yesterday, and I want especially to say that the interesting and kindly guidance of Miss Reddy added a great deal to our enjoyment.

I, myself, had never realized just what a remarkable institution the American Museum of Natural History is. I cannot express too highly my admiration for the quality of your work.

Philadelphia, Pa. ALBERT B. MARIS

• • •

SIRS:

Your letter containing a membership ticket for the American Museum of Natural History has just been received, and I am enclosing herewith my check for $[illegible]

At this time, it gives me great pleasure to say to you that I regard this membership as one of the most desirable of the organizations to which I belong, and your NATURAL HISTORY Magazine is certainly an amazingly interesting and instructive publication. My children and grandchildren enjoy it greatly. It is, in itself, worth more than the cost of the membership.

Upper Montclair, N. J. ALAN WEST

• • •

SIRS:

I have spent many lonely hours in this U. S. O. club reading your magazine and received a great deal of pleasure in doing so.

Being in a "Task Force" it will be impossible for me to continue reading future publications, and therefore I would like to know whether you have any gift subscriptions for service men.

Thanking you for your kind consideration, I remain,

CPL. JAMES LEWIS

New York, N. Y.

NATURAL HISTORY does not have any gift subscriptions at its disposal but welcomes such for men in the

Continued on page II.

PURE RESEARCH IN A NATION AT WAR

Like all social institutions, museums must remain ever conscious of their responsibilities to the society which provides their means of existence. Conversely, society cannot afford to lose sight of the benefits, immediate or remote, derived from the institutions to which it gives sustenance.

In times of national emergency and under the stress of wartime psychology there may occur a foreshortening of perspective, a narrowing of focus in social consciousness. In combating a social order that has capitalized on the immediate destructive powers of certain phases of science, the democracies could easily lose sight of the far-reaching rewards of other types of scientific research which are lacking in immediate practical application. It is in just this sort of pure research that museums have traditionally specialized.

Realizing the imperative necessity for preserving the integrity of democracy's social institutions, the President of the United States has created a Committee on the Conservation of Cultural Resources. This Committee's report strongly recommends that "space in buildings, libraries, art galleries, museums and archival establishments be not used, even temporarily, for purposes outside of the natural sphere of these institutions, and that no other hindrances be placed in their way . . ."

A similar point of view is expressed in the introduction to the twenty-third annual report of the Commonwealth Fund, which so generously supports scientific research throughout the nation. "Not forever will force reign, not always will the organization of society—or its disorganization—preclude the benefits to mankind of scientific discovery, of knowledge, intelligence and understanding. Whatever philanthropic foundations can contribute to the forging of implements for a better day will not be lost."

Perhaps the most telling argument in favor of continued support of pure research during wartime is revealed in an editorial which appeared recently in an English scientific journal that carries reports of current experimental investigations. "At the beginning of the war it was decided to suspend publication of the *Bulletin of Animal Behaviour* after only two numbers had appeared. Contributions continued to come in, however, and the present issue represents a reversal of the original decision of the Council." The continued influx of scientific reports proves the survival of research in a country which has suffered some of the heaviest attacks of the war.

The determination of our government, our large philanthropic foundations, and our allies in war faithfully to preserve and foster pure research in the face of compelling emergencies is one of the most reassuring and faith-inspiring signs of the essential worth of our way of life. It actually demonstrates the refusal of democracies to sacrifice, even under terrific pressure, those tools which they have laboriously developed for the eventual betterment of human society.

Frank A Beach

Curator, Department of Animal Behavior,
The American Museum of Natural History

Clear the Lines for the War

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2. Will it interfere with war calls?

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WAR CALLS COME FIRST

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Albert E. Parr, Director

VOLUME L—No. 2 ★ ★ ★ ★ ★ ★ **SEPTEMBER, 1942**

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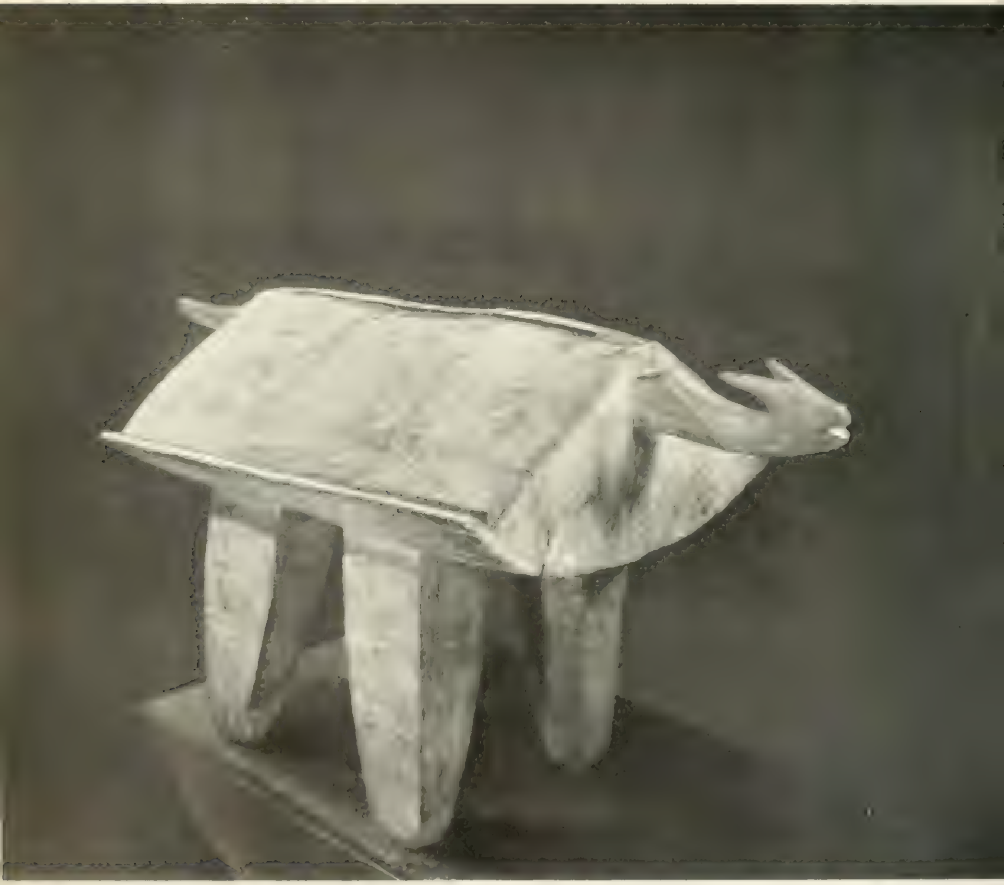
The travels of a TALKIN

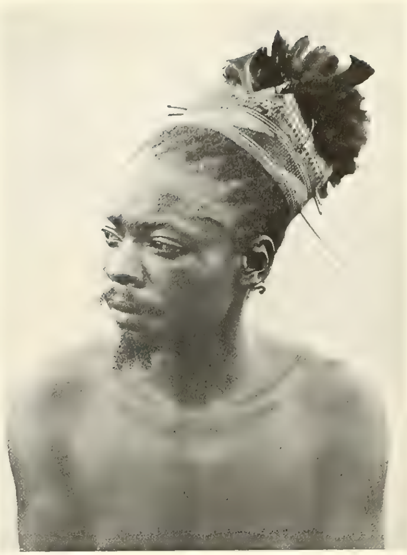
▼ Once used in cannibal country for sending messages from one village to another, this wooden drum is typical of the larger instruments that gave the native African a reputation for defying time and space in the transmission of news. Measuring 8½ feet long and 4 feet high, it projected over the sides of the largest dugout available for carrying it through the rapids of the Aruwimi



DRUM

By JAMES P. CHAPIN
Associate Curator of Birds,
The American Museum of Natural History

Illustrated with photographs by HERBERT LANG



➤ CHIEF ABIENGAMA of the Mabudu tribe, whose men made this drum. He was one of the most important chiefs near the post of Pawa in the northern Belgian Congo

Many adventures befell this signal drum and the explorer who procured it for the American Museum, before it could be placed on exhibit as a symbol of the primitive African's talent in the art of communication

IN A CORNER of the Hall of African Natives at the American Museum, for the past quarter-century, has stood a huge signal drum about four and a half feet high and five feet long, without counting its "head" and "tail" which protrude from the ends. Hewn from a single tree trunk, it has no skin drawn over it, for it is a "slot-drum" of the sort so widely used to serve as a "wireless telephone." Standing on four stout legs, with broad belly to give the utmost resonance, it was designed to suggest the form of a standing buffalo.

Many are the questions asked by visitors about this drum. Only the other day a teacher from Hampton Institute came to inquire with what tools it was made, how the wood was removed from the inside, and what kind of tree furnished the hard brown wood. Many a time have I gone to pound on its vibrant lips, evoking old memories of the country where it was made, the people who used it, the changes that have since come over their homeland, and above all, the man who enabled us to acquire it for the Museum.

Signal drums of this type are to be seen in many parts of the Belgian Congo, and in other countries of forested West Africa; but nowhere did they have a more interesting shape than in the country of the Mangbetu and allied tribes in the northeastern Belgian Congo. That region, often known as the Uele-Nepoko, after two of its rivers, has long been famous as a center of native art. Bountiful nature provided food without demanding too much effort, and leisure, under a warm, equable climate, was used intelligently in the development of social life and a surprising variety of handicrafts.

All was not peaceful, however, 75 years ago. The Mangbetu were then among the most celebrated of African cannibals, ruled over by kings like Munza, who tried to emulate Solomon in the size of their harems. Then some 50 years ago the Congo Free State extended its influence to Mangbetu Land; and the military activities of the Mangbetu and their rivals, the Azande, were frowned upon. Cannibalism was severely repressed, until it took refuge in the forests of the Nepoko area, finally disappearing as a normal practice only after the Congo became a colony of Belgium.

Under King Leopold's Congo Free State it was not easy to recruit in Europe the proper number of men with all the qualities needed for the wise administration of a distant, unhealthy wilderness in Central Africa. Among the Europeans attracted by the adventurous prospect of opening up the Congo to civilization there was bound to be a minority of reckless, irascible men; and though these were carefully weeded out as occasion arose, a few were apt to remain in the far corners of the country, even down to the days when the Congo came under the control of the Belgian Parliament and a wise Minister of Colonies. I can bear witness to the splendid achievements of the Belgians in Africa, and no other nation could have developed the Congo more fairly or efficiently than they.

[illegible] white men who brought the changes about, and even [illegible]

The echoes have been many, and with one of them [illegible] after making a purchase. Among the bills was one of rather large denomination bearing an engraved pic- [illegible] up into basket form. This bill was a new one to me, and I must have said so aloud, for a European standing [illegible]

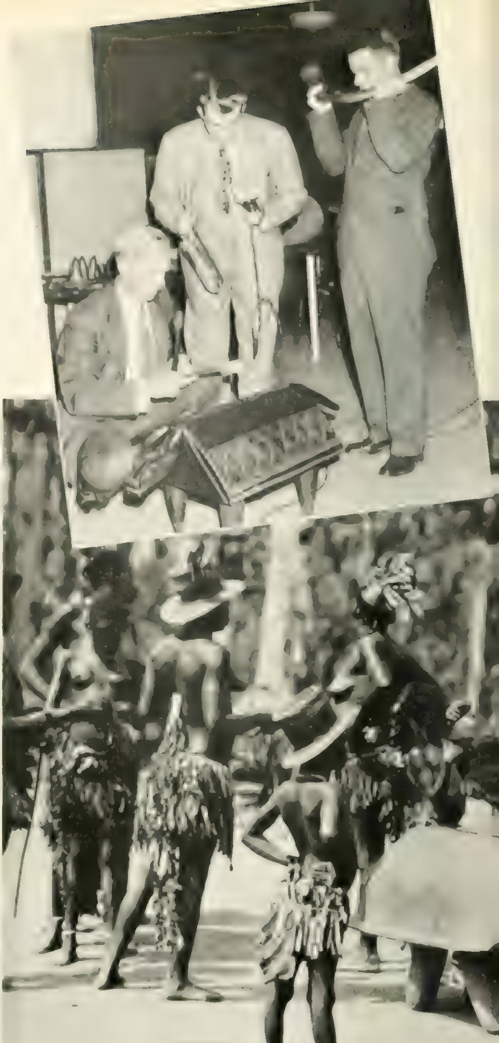
[illegible] Mangbetu [illegible]

I had lived and worked among the Mangbetu in the northeast Congo some 20 years before, and I naturally asked what he knew. My new-found acquaintance introduced himself as Monsieur Boccaccini, owner of the little hotel of that name in Coquilhatville. He then informed me that he had been one of the white officers who took part in a military expedition against the Medje in 1903. In April of that year the Medje tribe, which may well be regarded as a southern branch of the Mangbetu, had killed and eaten an American named Thornton. But by the time Herbert Lang and I arrived in the district in 1910, the Medje were being governed peacefully from a well-built Belgian post on a hilltop in the Medje forests.

I don't recall that Boccaccini distinguished himself [illegible] the Medje [illegible] Major Engh and Carl Eriksson were better known for that—but he knew something of Guyon. Chatting about these old times brought back a flood of reminiscences that extended all the way from this middle part of the Congo River to the little post of Pawa, near the borders of the Medje-Mangbetu district and back to the American Museum in New York.

Here in this town of Coquilhatville, sixteen years before I first heard of Guyon, a compatriot of Boccaccini, and the man who helped us secure that exceptionally fine drum for the Museum. The drum had been made by Mabudu people, but Medje, Mabudu, and Mangbetu lived as close together as people might in three different counties of New York State. All of them used these large drums to send messages from village to village and even to hunters and workers out in the forest. We saw them everywhere, heard them booming at night, sometimes with regular rhythm indicating that a dance was in progress, at other times with short periods of irregular pounding that were just as plainly serving the purpose of telephone messages.

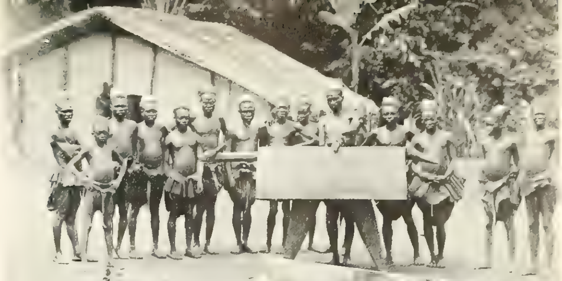
Every native chief of any account had one or more of these drums, each hewn from a single section of a great hardwood tree. The upper half had been hollowed out through a rather narrow slot along its gabled top; the lower half was largely cut away, leaving four solid legs for support; and at the ends were projections crudely sculptured to suggest the

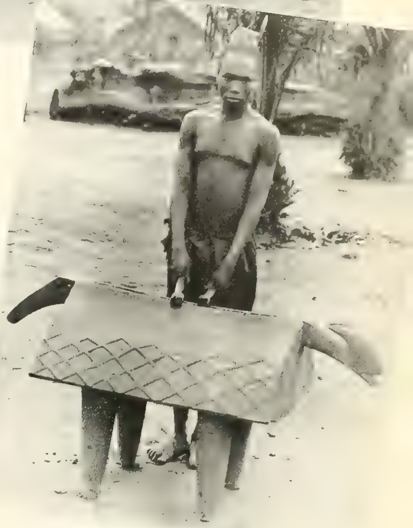


THE SIGNAL DRUM is often borrowed for dance festivals, as shown above. Note the sophisticated small boy (*foreground*) who surveys the scene knowingly, and the woman "strutting" on the right, expressing the spirit of the occasion. Dancers of both sexes wear frayed-out green banana leaves. This is in the northern Congo forest

◄ THE AUTHOR demonstrating the use of a smaller signal drum before the microphone in one of the American Museum's educational broadcasts. This drum is artistically carved to represent a buffalo, with geometric patterns decorating the sides in low relief

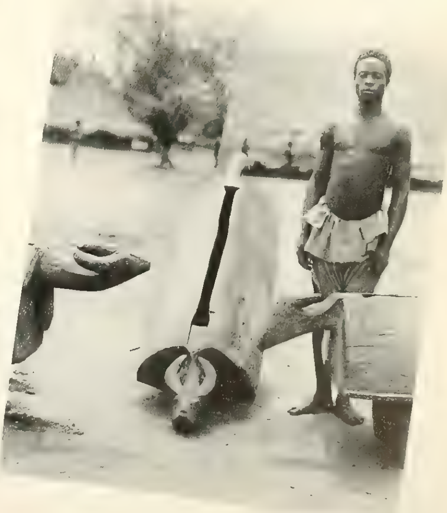
➤ A GROUP of young Mangbetus standing by the signal drum of Chief Danga, near the post of Rungu

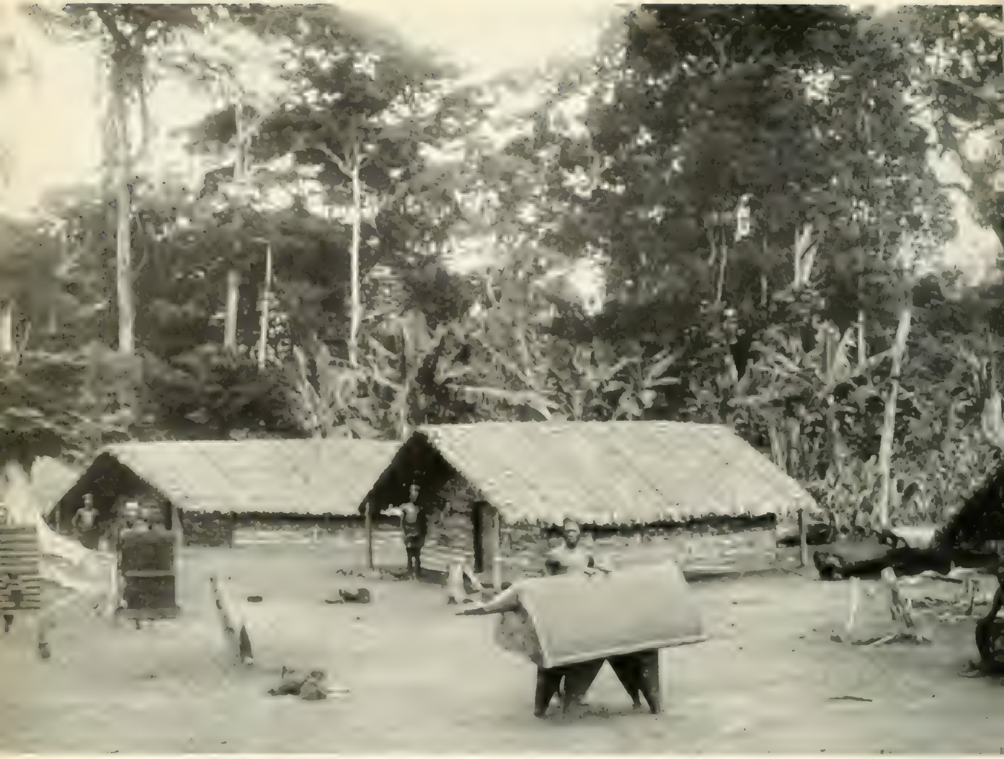




▲ A YOUNG AZANDE MAN with a signal drum, in the northern Belgian Congo, near Nala

➤ BUFFALO HEADS form a favorite motif in the carving of signal drums in this region. These are in the village of Chief Bafuka, an important head man of the Azande tribe, in the northern grasslands of the Belgian Congo





This scene in the village of a Mangbetu chief by the name of Niapu shows the customary signal drum in a prominent position. Note the two warriors standing with their spears and large wooden shields. The village is located just within the northern border of the Congo forest, near Rungu

▼ Here again the signal drum is being used to beat a dance rhythm. Lumps of crude rubber cover the ends of the drumsticks, which are wielded by a small boy. The dancers are adorned with leaves and wear skins of genet-cats about their waists. Small iron bells jingle at their ankles

▼ On the top deck of a Congo River steamer, a detachment of Congo soldiers receive their weekly ration of *kwanga,* manioc bread wrapped in green leaves (July, 1909). At right is Agent Militaire Guyon, who helped Lang and Chapin procure the drum for the American Museum

head and tail of a buffalo. These extremities served as handles for moving the drum about.

To transport such a specimen all the way to the Congo River where it could be placed on a steamer presented a serious problem. But we wanted one. The trouble was that the chiefs wanted them, too, and for months none would consent to part with his.

Two years had not elapsed since Belgium had taken over the Congo Free State. No money was yet in circulation among the natives in that northeastern section of the Belgian Congo, and all efforts to barter for a large signal drum failed. Taxes were still being collected in wild rubber—one kilogram per month from each able-bodied man in the region—, and as encouragement he was given trade goods valued at 75 centimes for each kilogram.

The post of Medje had two lesser stations dependent on it, Pawa and Babonde. In each of these lived a single European, whose main duties were to preserve order and collect the taxes. In charge at Pawa was Ario Guyon, Italian noncommissioned officer who had taken service in the Congo Free State a few years before, a big strong man and very bald. He was a braggart, a great drinker of palm wine when there was nothing stronger to be had, and proud of the many baskets of rubber delivered to him at the end of every month. "The King of the Mabudu," he would often call himself.

It must be admitted that willful men of his type often enjoyed greater respect from the native than we would accord them. Guyon's small detachment of native soldiers were rather proud of him, and when we visited Pawa we found it a small but well-ordered station.

We had first met Agent Militaire Guyon more than a year earlier, when he boarded our steamer at Irebu, a military training camp on the Congo just below Coquilhatville. He was taking a company of native soldiers up to Bumba. At that time he seemed on his good behavior and did not even touch the red wine served at the table. It was then or a little later that I heard a rumor to the effect that Guyon had once been accused of shooting one of his own soldiers, though he escaped conviction. That was in the Uele, and the accuser was a missionary. Now Guyon was to go back to the northern Ituri, where as yet there were no missions.

After we left Pawa our stay in the north, among the Mangbetu and other tribes of the Uele district, lasted much longer than expected. We had ample time to see many more signal drums, but none that we could readily have acquired. Moreover, Guyon wrote us that he had the one he had promised, a huge one, fashioned by men of the Mabudu chief, Abiengama. It was standing under a grass-thatched shed at Pawa, and was used to broadcast the time when each monthly tax in rubber fell due. No doubt it also served to tell the neighboring chiefs when rations were desired for the soldiers and workmen at the post, when porters were needed for transport on the roads, or a dozen chickens for the Chef de Poste's table.

When I finally returned to get the drum, more than two years had passed, the tax in rubber had been abolished, and Guyon had departed. The drum still stood under its shed, and as I looked at it I felt two very different emotions. It would make a splendid exhibit in the Museum, but what sweat and toil would be required to get it to Stanleyville! When

➤ A MABUDU CHIEF near Pawa, where Agent Militaire Guyon was the sole white representative of European authority

(Below, left) **A VILLAGE scene near Stanleyville. One man mends a fishnet, another sucks on his big tobacco pipe, while a third shows how the signal drum is beaten. Here the slot-drum retains the form of a tree trunk. But it serves the same purpose as elsewhere, passing news from village to village or out to fishermen in canoes on the river**

(Below, right) **TWO CYLINDRICAL signal drums and another flat wooden drum in a riverside village of the Wagenia, near Stanleyville. The palm-thatched shed serves as a loafing place or "club" for the men during the daytime and gives shelter to the drums during rainstorms**

[illegible] where perhaps a dugout canoe might be found to [illegible] paid in Congo francs and centimes, a little over ten American cents per day each.

I already had a caravan of 60 porters traveling with me, and the drum could never keep up with them. So I went on to Avakubi on the Ituri, and arranged for one of our workmen, Gadangwa, to follow later with sixteen men bearing the drum. It makes me wince still to think of the hard work they had getting their heavy burden over the hills near Manamama, along a "road" that had never been traversed by a cart and which was little more than a wood-path with the underbrush cleared out along its sides.

It was many weeks later when Gadangwa arrived in Avakubi, to tell me that our drum was standing in the resthouse at Bosobangi, one day's march down the river at the foot of some bad rapids. I went there to arrange for its transport down the river, to Banalia on the Aruwimi, thence overland to Bengamisa, and finally by canoe to Stanleyville. The largest canoe available at Bosobangi was not quite as wide as the drum, so its edges had to rest on the gunwales, and off went our treasure on the next watery stretch of its journey toward America. The canoe looked top-heavy, and there were plenty of rapids ahead, but the boatmen of the Aruwimi are experts.

My next meeting with the drum was in a large government warehouse at Stanleyville, still more than 1000 miles from the mouth of the Congo, where all the collections I had been sending ahead by road and by canoe were stored for us. Now it was October of 1914; the first World War was on. Troops and munitions were streaming through Stanleyville toward the Kivu and Tanganyika fronts under attack from German East Africa.

The drum had to be crated. One leg was cracked, but otherwise all was in perfect condition. A part of the lumber that had been shipped out for our final packing was ruined by termites, but Lang was a Hercules at packing, and I tried to do my bit. Finally in December I was instructed to accompany the first shipment of boxes destined for New York and left for the Lower Congo on the freight steamer *Roi Albert*. I do not recall whether the drum was in this first shipment, but all our collections got home by much the same route.

The German occupation of Belgium had disrupted steamer service from Europe. I waited a month at Boma on the Lower Congo and was fortunate to obtain passage on the first steamship that called there in 1915, the *Bornu*. Our ship, with those precious collections aboard, was bound for Liverpool. At the second port of call, Libreville in the Gabun, we learned that the Germans had declared a blockade of Britain, to be enforced by submarines.

There was, of course, no possibility of turning back or of transshipping my cargo. Indeed, all the collections of our Congo Expedition had to find their way home by way of England through the submarine blockade. The *Bornu* was a slow little freighter, with cabins for a dozen passengers and a maximum speed of [illegible] knots. She picked up a cargo of lumber, palm oil, and palm kernels at a succession of ports along the African coast, delivered bags of kola nuts at Dakar, tarried a day in the Canary Islands [illegible] up the Irish Sea in broad daylight, an easy prey to a submarine if luck had not been with her. Safe in Liverpool, six long weeks after leaving the Congo, I thanked heaven and made arrangements to have my freight taken to New York by the American Line.

The drum, I regret to say, now has some initials of New York boys carved on it. Little do they dream of the story behind the drum, its makers, its travels, its escape. But most tragic of all was the story of Guyon himself.

As I mentioned, he had left Pawa, and I heard no more of him till I was about to start down the Congo River. Then it was reported that he was again stationed at Coquilhatville, so when the steamer stopped there I stepped ashore to look him up. To my surprise I encountered Major Kruger, another old acquaintance in the region of the Medje. I asked him if he knew where I could find Guyon.

"Yes, he is here," I was told, "but you won't see him. Not long ago he was playing cards with a few of his friends. They had been drinking. Guyon angrily accused one of the players of cheating, seized an Albini rifle, and shot him. Luckily the victim is now recovering, but you can't see Guyon, he is in jail."

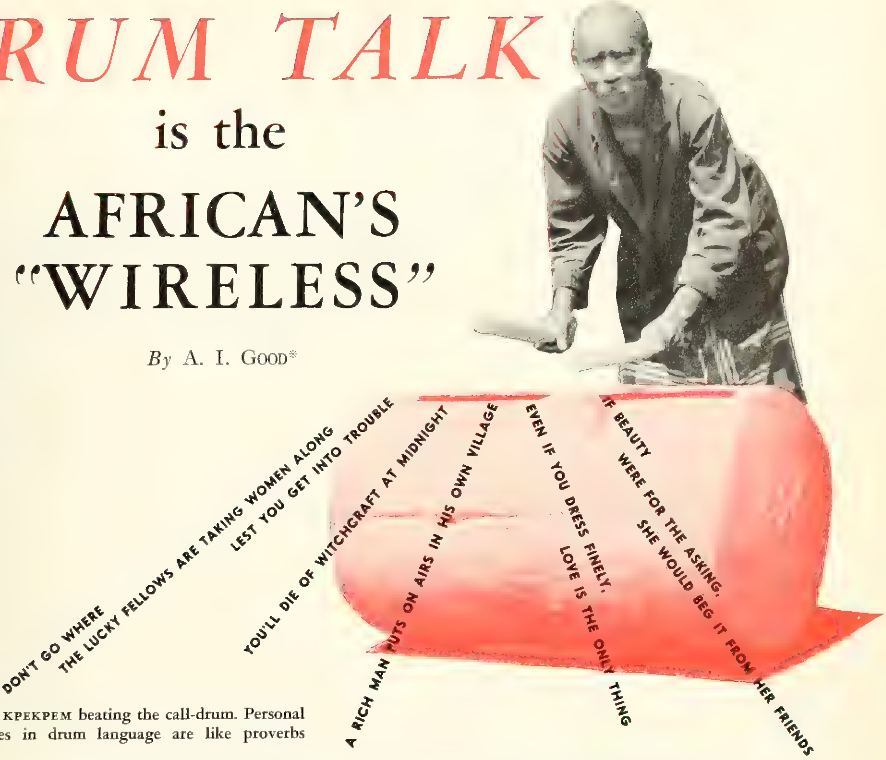
That was certainly the end of his career in the Congo, but looking at the drum I shall always recall its history and wonder what message a Mabudu drummer might have pounded out of it to broadcast the sad fate of the "King of the Mabudu."

Africa is now shaken by another world conflict. But it is a different Africa from the one we explored in those earlier days. Many of the old trails have been supplanted by modern highways, and over and above the magic beat of the talking drum echoing through the virgin forests, radio waves carry their other messages back and forth across the continent, presaging we know not what.

But lest an ancient art be lost, let us not forget the marvelous system of communication invented by the natives of "Darkest Africa." These people had no written language; handwriting was utterly beyond them. Yet they devised an ingenious method of making a drum "speak" for them, so that they could send almost any message they wished and over considerable distances by means of relays. No other primitive people outside of Africa ever developed so fine a system of transmitting thought through space. In the eastern Congo innumerable tales used to be told of how news of the coming of some European would arrive a day or two ahead of him, giving his identity, the number of soldiers or porters accompanying him, and the purpose of his visit. Most of the popular accounts in books of travel are superficial and inaccurate, while the few good discussions, chiefly in German and French, are hidden away in technical journals. So for the explanation of drum talk I turn you over to another old friend of mine, Dr. A. I. Good, who will tell you in the article following this one what he has learned of it over a period of many years spent in French West Africa.

DRUM TALK
is the
AFRICAN'S "WIRELESS"

By A. I. Good*


DON'T GO WHERE
THE LUCKY FELLOWS ARE TAKING WOMEN ALONG
LEST YOU GET INTO TROUBLE
YOU'LL DIE OF WITCHCRAFT AT MIDNIGHT
A RICH MAN PUTS ON AIRS IN HIS OWN VILLAGE
EVEN IF YOU DRESS FINELY,
LOVE IS THE ONLY THING
IF BEAUTY
WERE FOR THE ASKING,
SHE WOULD BEG IT FROM HER FRIENDS

Old kpekpem beating the call-drum. Personal names in drum language are like proverbs

How the black man was able to send out his messages of joy or sorrow over jungle and valley long before the white man invented the radio

The log is expertly hollowed out until the curved sides are only about half an inch thick and give different tones

Listen to that drum beating in a town a mile away. "Tap-tap-tap-tapping, tap-tapping-tap-ping-tap!" How clearly the beats sound out over the forest. How exactly the call is repeated, its tempo the same every time, every pause in precisely the same place. But wait, it changes, and now goes "Tap-tap-tap, tapping! Tap-tap-tap, tapping! Tap-tapping, tap-tapping!"

You ask your native companion, "What is that drum saying?"

He looks sheepish, but answers, "Man call chief come quick, say white man come." It is all a mystery to you; but 20 minutes later, when you arrive in the town, the chief is there waiting with a present of two eggs for the white man. You decide there is something to this drum business.

---

* Dr. A. I. Good has lived in West Africa for many years as a missionary in a region pioneered by his father. His observations on the native "drum-talk" in the sections where he has traveled enable him to write the first popular article on the subject ever published in an American magazine.

[illegible] quickly." The chief, off in his garden, understood [illegible] getting ready a small present.

The black man's wireless telegraph

I [illegible] Africa, how long [illegible] the black man had developed his own peculiar system of wireless communication.

He needed it, for in the heart of the tropics the [illegible] forest. Roads were non-existent, only footpaths traversed the jungle. Men went far into the forest to hunt. Women traveled long distances to their garden-clearings. If something happened in town, how could they be informed? An important man died; his funeral was a major event in the primitive community; how was word to be spread? A man's wife ran away; how could he tell the people along her path to catch and hold her?

Sickness, death, war, hunting, fishing, all are of prime importance to the savage. The practical answer to all these needs is the drum. In many parts of West Africa these wooden drums are also known as "gongs." Messages beaten on the drum could call individuals miles away in the forest or broadcast news to distant villages. By relaying it from town to town a large area could soon be apprised of news vital to all. Though the white man has in recent years perfected his wireless to cover thousands of miles, remember that the primitive African savage invented his "wireless" long before a European ever thought of it.

How far?

An ordinary drum can be heard easily in the daytime at three or four miles. In the dead of night the best drums carry ten or even fifteen miles out over the forest. I knew of one exceptional drum that has been heard 25 miles, though its message could no longer be understood. Three factors, in the main, determine the range: the size of the drum, its individual quality, and the type of country.

Medium-sized drums carry farther than the very small or the exceptionally large. Individual instruments differ widely in resonance, because of the kind of wood used, or even more as a result of construction. A good drum-maker becomes widely known. In certain sections the topography is of importance, long valleys or river courses aiding transmission in their direction. The range of any given drum therefore varies greatly.

The Bulu, together with the Yaoundé, Bene, Ntum, Okak, and some other peoples, are all part of the great Fang tribe which extends clear to the [illegible] French Gabon. While each of the [illegible] dialectic differences, the [illegible] Any one of the dialects would be understood wherever Fang is spoken. Fang [illegible] to that great language family known as Bantu, which extends all across equatorial Africa, and south nearly to the Cape.

It is true that the drums vary in form over the vast expanse of Africa in which they are used to send messages. Certainly also the drum-calls differ between distinct languages, for phrases from the language in use are beaten on the drum. We venture to assert, however, that the basis of message transmission by drum is the same wherever the system is used. In this article we shall confine ourselves to the drums and drum-calls of the Bulu people, with which we are familiar.

The call-drum is a hollowed log of wood. Some three kinds of hardwood trees are used by the Bulu for making it. The *mbel* tree, or barwood (*Pterocarpus osun*, of the family Leguminosae), is often employed, as is also the [illegible] (probably *Pentaclethra macrophylla*, of the family Mimosaceae). The latter is acacia-like, bearing large pods. Another hardwood tree with thorny bark, the *olom* or *ololom*, is equally good.

A small drum will require perhaps a two-foot section of log, while a large one may reach a length of three and a half or four feet. The log is hollowed out roughly through a longitudinal slit while still lying in the forest. The slit is three or four inches across, and runs nearly the whole length of the log. After its weight has thus been reduced, the log is slung on a pole, brought into the village, and the finishing touches are then added. The sides are carefully hollowed to the required thinness and smoothed off, by the use of a chisel-like tool inserted always through the same slit. The curved walls of the finished drum will be but a half-inch or less in thickness, the ends being left two or three inches thick. This makes a hollow cylinder with closed ends, highly resonant when dry, the only opening being the slit along the top.

When the slit is first made, a small section of wood is left connecting its opposite edges, a little to the left of the exact middle. This is known in the Bulu tongue as the *otat*, or crier. Later the small section is separated into two blocks of different size, each adhering to its side of the slit, separated from the other by a crack one-quarter inch wide. One, known as the "man," is nearly twice as broad as its mate, called the "woman."

When I inquired why these blocks are situated to the left of the middle, the answers, though indefinite, were to the effect that if they were right in the center the tones would be somewhat jumbled, or muffled. If slightly off-center, the tones of the drum would be clear. Possibly it is a matter of overtones, not understood but learned by experience.

There are two drumsticks about a foot long, one for each hand. The best are sections of the midrib of the frond of a palm, *Raphia vinifera*, the flatter lower side being struck against the drum. Rounded sticks may also be made from the soft, light wood of the common umbrella tree, *Musanga Smithii*, called by the Bulu *aseng*. They may be of equally soft white wood from the *avom* vine or tree, a member of the family Anonaceae, probably *Cleistopholis Staudtii*. Harder woods wear away the lip of the drum too quickly. It is beaten on the edges of the slit, just on each side of the "man" and "woman" blocks, the drummer standing on the "woman" side.

To secure the best resonance and carrying power, the drum should be supported on ropes roughly woven from the outer fibers of plantain or banana plants, or from the dried fronds of the same plants, upheld by a frame of forked sticks driven into the ground. A small thatched roof may be built over it for protection from sun and rain, and a piece of bark laid over the slit. The drumsticks are usually kept in the cavity of the drum. At the close of a drum-call the thump of the sticks as they are dropped in is characteristic. For a small drum the special support is not worth while. It is kept in the palaver house of the chief, to be carried out and laid on the ground as needed.

The basis of message transmission is tone. Many of the Bantu languages are "tonal" in character. To be properly spoken, they require that each word be pronounced in its correct tone. There are five different tones in the Bulu language, but most words are either in the two lowest tones of the register, which are not far apart, or in the two highest ones, likewise close to each other. The middle tone is used with relatively few words, and so is practically negligible. Roughly speaking nearly all words can be classed as high or low; this two-tone division is the basis of the drum-language.

The two sides of the drum, chiefly because of the difference in thickness and also because of the two blocks of wood unlike in size—the "man" and "woman"—produce two distinct tones, one considerably higher than the other. These high and low drum tones can be made to correspond to the high or low tones of the language, by striking on the appropriate side of the slit. Thus the tones of the message are beaten on the drum, and the hearer reads them back into the original words. The meaning becomes clear.

It would seem that the two blocks within the slit are not essential. When the drum becomes worn, and the blocks break off, the tones continue to be separable, even though less clear. Recently I have seen a large drum where the "man" and "woman" blocks were on the wrong sides with reference to the tones. Evidently the maker had made a mistake but had compensated for it in the thickness of the drum-walls. The tones were still clearly separate, though in this case the "woman" block was on the low-tone side, the "man" on the high-tone. The thickness of the walls is most important, and I have known a man, as he was making final adjustments, to chisel off a little wood from one inner side, and then to tap it to get the tone. He was tuning his drum as the piano tuner makes the adjustment of a string.

This use of the tone of words for the words themselves explains the ability of natives to understand one another when calling at great distances. They are not hearing actual words, but rather a series of tones. In fact the Bulu sometimes employ a language, if so it may be called, of pure tone without words, to which they give the name *kili*. Individuals too far apart to hear actual words call back and forth using only the syllables "ki-ki" in the tones of the words they would employ in ordinary conversation. Short sentences are transmitted and understood. This I have watched many times, and the principle is the same as that of the drum-language.

Drum-calls are in a sort of code. In sending messages on the drum the operator does not choose any sentence at random. There are a large number of fixed expressions, either drum-names of persons or drum-sentences conveying certain ideas. The sentences have a literal meaning, but this may not be their true significance for the message. We sometimes cable a ten-letter code word of jumbled letters, or else a ten-letter word that means something; either will work, the message is to be found in the code. Accordingly, "a hill is a great thing" is a logical statement, but its real message is that a man otherwise known as Ndongo is being called. "Only folds folds hands [on] breast" may convey an idea, but it really means, "He is dead." However many ways there are of saying this in ordinary speech, on the drum there is only one, a code sentence intelligible to drummer and hearers.

These fixed code sentences are beaten on the drum, and the listeners, from the tones alone or perhaps with the aid also of the rhythm of the sentence, can decode the message again so as to seize its true meaning. The rhythm of the code sentence is the same as it would be if spoken rapidly with heavier stress on one word than on another, or on some syllable of a word. But I could detect no rhythm peculiar to the drum; and the tones, I believe, are the most important element in the recognition of the sentence.

We can understand why many young natives, these days, can neither beat the drum properly nor interpret its voice, for they have not learned the fixed sentences. Likewise the white man can scarcely become proficient in understanding them, because he must have perfect command of the language and its tonal qualities. But the native ear can, with proper training, translate the tones of the drum into the words that correspond. It takes considerable practice for a white man to recognize his own drum-name, if he has been given one.

Examples of drum-calls

Every man and most women used to have an individual drum-name, a fixed code sentence. Sometimes it seemed to have no particular meaning. In other cases it seemed to refer to one's character or some other circumstances. My father, Dr. A. C. Good, the first white man in South Cameroun, was continually traveling hither and yon in preliminary explorations. He was given this very significant drum-name by the Bulu: "Going, going, going, what are you going to look for?" The writer's drum-name was given by some old men, probably because he is an only child: "You walk alone, where are your brothers?" Women might have names referring to them as superlatively beautiful, or occasionally the opposite. Sometimes the names were handed down to younger members of a family as their elders died off. A man when asked recently his wife's drum-name replied: "No. I tried to give her one, but she wouldn't accept it, and her own family never gave her one." She must have felt that her own family should have provided it. If you

[illegible]

[illegible] With the advent of European civilization and education many old native customs are disappearing, and with them the drum-names. The younger generation neglects the drum and consequently does not possess drum-names. As the older generation passes, first-class drummers become scarce, and it is mostly the elders who can still interpret the calls. Eventually the art may disappear.

A few examples of drum-names, translated into English, are these:

"[illegible] child."

"[illegible]"

"[illegible]"

"[illegible]"

"[illegible] to die."

"[illegible]"

The stealthy gait of a chameleon as it prepares to shoot an insect with its tongue is well known. Other names refer to the francolin scratching in the forest, or the parrot raiding palms for their fruit.

Some drum-names can belong only to women:

"Even if you dress up finely, love is the only thing."

"She is better than the daughter of other tribes, she who stands there."

"If beauty were for the asking, she would have begged it from her friends."

"[illegible] out its treasure."

"[illegible]"

[illegible] are lost when such names are rendered in English.

Other messages sent on the drum

Aside from drum-names, the actual messages beaten on the drum are surprisingly few—in the Bulu country at least—and limited to certain essential information. Food is very important. Suppose a man returns unexpectedly from a journey or from hunting, only to find his wife absent in her garden off in the forest. He is hungry and may call her in this manner: *first*, her drum-name; *second*, his drum-name; *third*, the message as follows:

[illegible]

"Come walk quickly, quickly. I feel hunger not small."

If a man is very sick, after his name comes:

[illegible]

"He is as weakening, weakening."

If he has died:

[illegible]

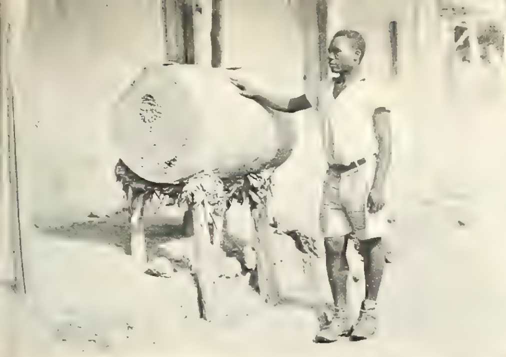
"Only folds folds hands [on]-breast."

To call people to go hunting in the forest with nets into which the game is driven:

[illegible]

"Little antelope is tied up tight, tight, tight."

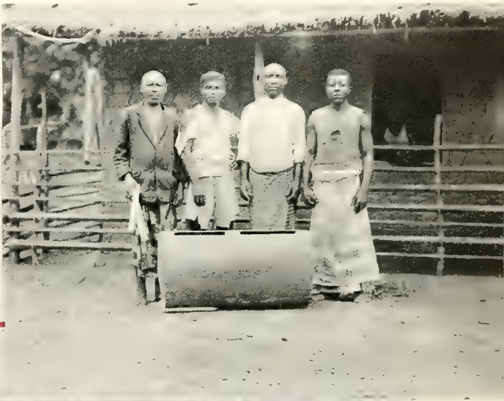
A CHARACTERISTIC village in the Cameroun. On the left is a drying-rack for cocoa, the chief product of the country. Beyond it are oil palms and a sheep wandering across the street. Behind the houses begins the forest



DRIED banana leaves serve as a buffer between this drum and its mounting, that it may not lose its resonance. It rests just under the eaves for protection from rain

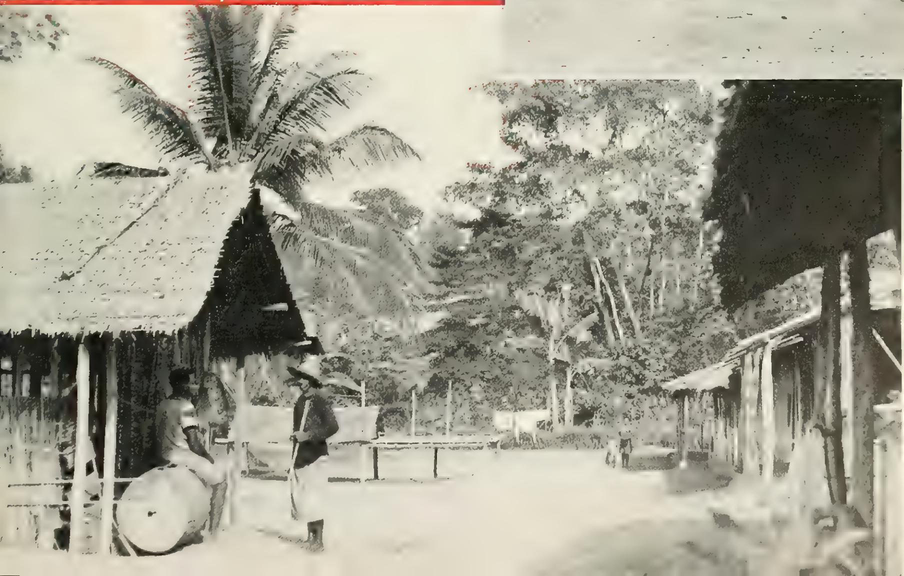
THIS poor old drum has lost its resonance and will no longer carry any distance. But the two tones can still be differentiated, which explains why it was used so long

FOUR VILLAGERS. Their names: "You are overcome with greediness, just as they were about to hand it [food] to you," "Tied up, tied up tight! Tied up, tied up, loosened," "Don't go where the lucky fellows are taking women along lest you get in trouble," and "You'll die of witchcraft at midnight"



IN OR OUT of the palaver house, the drum is a convenient seat. The very small child far down the village street is an albino native.

Though the grand masters are growing scarce, it is to be hoped that the new generation will preserve the unique art of drum talk



[illegible]

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

[illegible] had to be called with a drum beat.

In order to warn people to kill a leopard that [illegible]

[illegible]
[illegible]

[illegible] follows:

[illegible]
[illegible]

In [illegible] a wrestling match was a tribal contest of great excitement, but the custom died out because of governmental disapproval. The matches [illegible] used to go out over the forest:

[illegible]
[illegible]

During the match there was always plenty of drumming, for no African assembly is truly happy without a maximum of noise. There were dance-drums made of a hollow log four feet long and covered [illegible] hands only. The call-drums were then used mainly to accompany the dance-drums, not issuing any message. But in the hands of a skillful operator, the call-drum could be used to encourage one of the wrestlers, to warn him of a coming hold, or to advise him to take advantage of an opening. Coaching from the side lines is far older than American baseball.

At dances the call-drum is commonly employed for the same purpose as other types of drums, to beat the time. But it can also advise a special dancer, if need be, to stand up, sit down, come out, turn his back so, or stoop forward.

The actual messages that are usually transmitted by drum in the Bulu country by code sentences scarcely exceed a round dozen. The use of other than such fixed sentences would throw the listener into the mass of tones of general speech and result only in confusion. Remember that the hearer of a distant drum-call has nothing to work with but the two tones and their rhythm.

We might illustrate how the tone pattern of a drum-call is beaten as follows, using the upper level to show the syllables beaten on the "woman" side of the drum, and the lower level to show those on the "man" side:

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
"You walk alone, where are your brothers?"

[illegible] given to drummers is as follows: Don't lean over the drum, but straighten up, or its sound will be muffled. Look in the direction you [illegible] Don't hold your arms against your body, spread them out, and the sound will carry farther. A good drummer must not eat chicken wings, give them to someone else. The flapping of a chicken's wings does not sound far, they won't help.

Present uses of the drum

In [illegible] especially to call the people together to "talk palavers," or discuss topics of general importance and cases at law. Most of these had to do with property rights in women. A woman was sold in marriage by her father or brother. She might die without having been fully paid for; and she bore children whose ownership could be questioned. Thus she was a chief topic of conversation and even dispute. "Palavers" about women lasted for hours.

In the quiet of evening or just before daybreak, when sound carried best, the local drummer exhibited his skill by calling the drum-names of all persons of importance in the vicinity, one after another, scores and scores. Each man listened for his own name, and felt injured if omitted from the roll call.

Nowadays the drum serves instead of a bell for the various missions, Protestant and Catholic. Every village chapel has its drum; and the drummer calls the roll of drum-names as an invitation to the services, thus helping to preserve the art as its older uses dwindle.

Before a recent Sunday service, I took down a list of 52 drum-names, with the help of three or four men who knew drum-calls. We sat in a house, out of sight of the excellent drummer; and the men gave me each sentence before the next started, sometimes even before it was quite complete. Without their knowing what might come next, they amazed me by identifying every call within five to ten seconds. They probably knew 200 and more such names.

It was hard for me to write down enough of each name-sentence to be able to complete it later. At the end of 20 minutes I stopped the drummer, who could have continued. Later in the day a near-by chief asked who beat the drum that morning. He had noticed the difference between an expert and the indifferent drummer who usually performed.

It works

A year or so ago I stopped in a Bulu village where a man lived whom I wished to see. But the man had been off in the forest for hours, at work in his garden. It would have taken an hour for someone to walk there and bring him back, so I asked if he could be called with the drum. A little drum was brought out from the palaver house, and the tap-tap-tap went out on the air. I waited. In a half-hour, almost to the minute, in he came. "I heard you called me," he said, "what is it you want?" The drum certainly can talk.

THE PIKA HARVESTERS

By JOHN ERIC HILL
Drawn by
G. FREDERICK MASON

IT IS strange that any close relative of the rabbit should store food against hard times; because the rabbit himself is quite careless in such matters and lives a life as free from industry as the cricket in the fable. But the pikas live where the deep snows of winter cover all their food; and since they do not hibernate, they would starve if they did not store provisions.

These small mammals, which are also called conies or rock-rabbits, live in the western mountains from central Alaska to the Sierra Nevadas of California and to northern New Mexico. They make their homes in masses of broken rock, generally on the higher peaks near timberline, but where conditions are suitable they may be found much lower. Often the first signs of their presence are the little piles of hay, under and between the rocks. If one should wait quietly a gray, tailless mammal, slightly larger than a guinea-pig may slip noiselessly to the top of a boulder and utter a clear, squeaking "bleat," which once heard is unforgettable. If the pika has not been seen moving (and they move very quickly and then freeze for a few seconds), the little bleater is hard to locate; the sound seems to come first from one place, then from another. Pikas are timid, as they may well be with so many predaceous birds and mammals as enemies, but they are full of curiosity and if not molested they often ignore the presence of a person watching them.

During the early summer these rock-rabbits take life easily, but with the first frosty nights the old pikas become serious harvesters. All day long they travel back and forth from the rock pile, their home, to the weed patches or grassy slopes near-by. They nip off grasses and the leaves and green parts of food plants, and fill their mouths with bulky masses of the material. Sometimes a load may be almost as large as the little harvester's body, and their activities present an interesting scene as they scamper surefootedly over and under the rocks to one of their haystacks. A large pile may contain a bushel or more of the dried and drying hay, and they often use the same places to pile the hay year after year.

Then during the winter the pikas slip through their blacked-out galleries of rock and dine upon their stores of dried food. When spring comes again to the highlands, little remains of the haystacks but the woody parts of food plants that have been rejected.

Pikas are also found in Asia, east of the Ural Mountains. They have much the appearance of the "conies" mentioned in the Bible, but the latter, which can still be seen in the Near East, are different in skull and teeth, and are more properly called hyraxes.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Fall, 1942.

•

SUNDAYS over the Mutual Broadcasting System (WOR) from 9:30 to 10:00 A. M.

This Wonderful World. Quiz program, with young people answering questions on nature subjects.

•

WEDNESDAYS over WNYC from 3:30 to 3:45 P. M.

Science For the Seven Million.

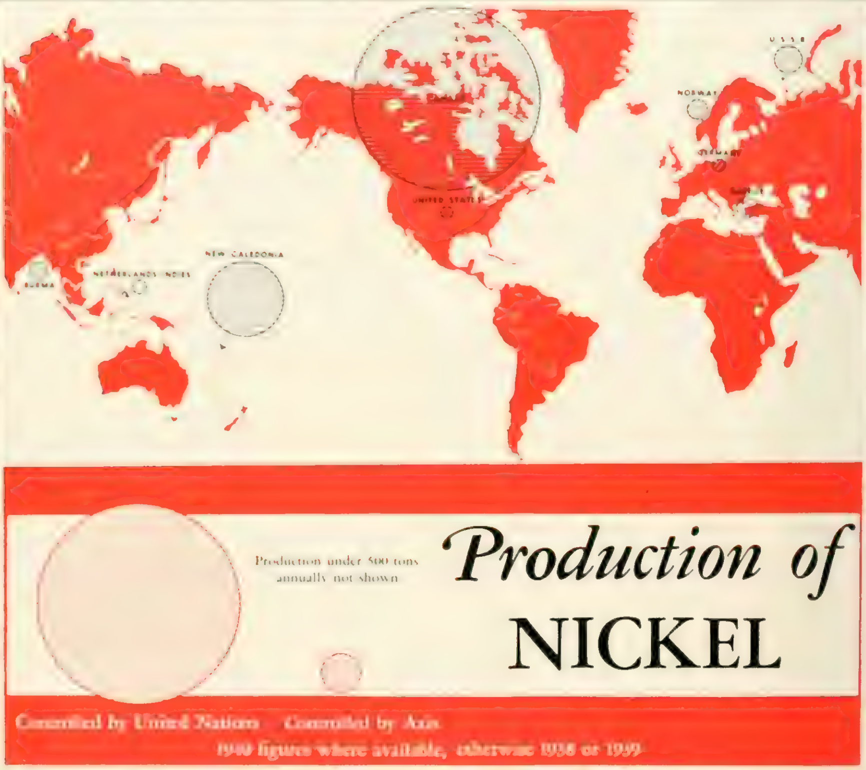
•

FRIDAYS over the Columbia Broadcasting System from 4:30 to 4:45 P. M.

Exploring Space. Science in the sky.

STRATEGIC METALS

NUMBER VII


U.S.S.R.
NORWAY
GERMANY
CANADA
UNITED STATES
NEW CALEDONIA
NETHERLANDS INDIES
BURMA
Production under 500 tons annually not shown
Controlled by United Nations
Controlled by Axis
1940 figures where available, otherwise 1938 or 1939

Production of NICKEL

Shortage of nickel impairs the strength of all armor and machinery and can even cause steel parts to snap in winter weather

By FREDERICK H. POUGH

[illegible]

NICKEL is second only to manganese in importance in the production of armament. Its role in steel manufacture is as a toughener. It is necessary in all forms of armor plate, in all sorts of steels for machinery, and it even serves a useful function in cast irons. In addition to its toughening effect upon steel it gives other important properties such as resistance to corrosion, heat, and stress.

Although nickel is on our strategic metals list, the American people need have no fear that Allied control of the world's production will be lost, for this metal is found in great abundance not far from our borders, in Canada. The International Nickel Company has had a virtual monopoly of nickel production almost since it commenced work in 1887. The mines at Sudbury, Ontario, were opened as copper mines, but it was soon found that the nickel far overshadowed all their other products, which include gold, silver, platinum, palladium, rhodium, ruthenium, iridium, selenium, and tellurium.

The only mines of consequence outside of Canada are those in New Caledonia, in the South Pacific.

These two regions produce two vastly different, yet related types of ores. Nickel ores occur in association with what are known as basic igneous rocks. The nickel is in iron-magnesium silicates, and when these alter, as they readily do, through action of solutions as they cool, or under conditions of atmospheric weathering, they are transformed into serpentine, and the nickel has to go along. So, as iron is removed by solutions or goes into limonite formations, we get a whole series of these nickeliferous serpentines, some of which may be almost half nickel oxide. The New Caledonia mines produce this type of ore.

The Sudbury mines are similarly in basic rocks, but the exact origin of their ores is still a subject of controversy. The too simple explanation is that a vast sheet of basic magma differentiated during crystallization, permitting a series of sulphide minerals to settle to the floor of the sheet, the most abundant of which is pyrrhotite, an iron sulphide. Subsequent sinking of the rocks beneath the norite sheet developed a more or less continuous saucer-shaped deposit underlying an area 16 by 36 miles. Geologists are unhappy about so simple an explanation and keep finding evidence for new complications of subsequent intrusions, replacements, and so on. In any case, however, the nickel is clearly associated with the basic igneous rock.

Pyrrhotite is the principal ore of nickel, a sort of frustrated mineral which does not have quite enough iron

Continued on page 103

Both the animal and metal which give our "buffalo nickel" its name are identified with the North American continent. Axis nations are melting down their nickel coinage which, perhaps in anticipation of their shortage, frequently contains much more nickel than the 25% in our five-cent piece

Nickel is vital in certain corrosion resisting alloys, among them stainless steel, which gleams atop the Chrysler Building *(right)*. The ore pyrrhotite *(at bottom)* has a metallic luster when fresh but soon tarnishes, unlike the alloys it makes possible

Keystone View Co. Photo

UNITED·STATES·OF
FIVE CEN

AMNH Photos

A *MALARIAL* Invasion f

The dramatic story of an attack upon the western hemisphere by one of the most dangerous mosquitoes, and science's successful campaign against it

[illegible]

If Orson Welles in his famous broadcast had announced [illegible] Martians had landed in New Jersey, but that a certain mosquito from Africa had [illegible] on the American continent there would have been no public alarm. It is doubtful if there would have been any public interest. But the mosquito [illegible] is potentially a much more dangerous invader than the Martians would have been. H. G. Wells's Martians, it will be remembered, were unable to adjust themselves to life on this planet and quickly died. But when the mosquito actually did invade Brazil from Equatorial Africa in [illegible] it proceeded to make itself very much at home.

What is this new invader of the Western Hemisphere and how did it get here? Anopheles mosquitoes are malaria carriers; *Anopheles gambiae* is the most dangerous member of a dangerous family. It is the scourge of Central Africa, a carrier of [illegible]

WHERE IT GAINED ITS FOOTHOLD

◂ ACCIDENTALLY carried to the New World in an airplane or fast destroyer, the mosquito that is the scourge of Central Africa found favorable breeding grounds in stagnant sunlit pools like the one at left. The wax palm, or carnauba, is typical of the landscape

n *AFRICA*

By Raymond B. Fosdick

President, The Rockefeller Foundation

and often fatal type of malaria, sometimes complicated by the so-called "black-water" fever. Its principal home is the African tropical belt, extending from the southern borders of the Sahara desert south to the Zambesi River, and it has also been reported from Algeria and Morocco, and from Southern Arabia.

A mosquito cannot fly across the Atlantic Ocean, and until 1930 this insect had never been seen in the Western Hemisphere. In that year, however, or shortly before, it crossed the ocean. It did not invade like an army; a single fertilized female may have been the cause of all the misery that followed. This tiny enemy alien was able to enter America because of modern methods of rapid intercontinental travel. An airplane, which a few hours before had received passengers in West Africa, alighted on the coast of Brazil, and when its door was opened the unwanted immigrant flew forth undetected, to begin the colonization of a new continent. Or perhaps the stowaway took passage on one of the fast French destroyers which at that time were working in connection with the French Air Lines between Dakar in West Africa and Natal in Brazil, and drifted to shore from the deck of the anchored vessel.

It was Dr. Raymond C. Shannon, a member of the Rockefeller Foundation's staff, who first discovered the insect in 1930 within the city limits of Natal, during a routine mosquito survey in connection with the Yellow Fever Service. The seriousness

◂In the rainy season, sluggish streams offered an extensive haven. Even a rain-filled hoofprint or wheel track was sufficient, as the gambiae mosquito takes only seven or eight days from egg to adult

▸In the Jaguaribe Valley over 90% of the population was afflicted in 1938. At right, an investigator against the spreading menace finds evidence of gambiae in a sugar cane irrigation ditch in this area

1

2

3

4

APPING SECTION. So that no
ools would be overlooked, the
kefeller Foundation and Bra-
n Government mapped the whole
on aerially

XAMINING BLOOD for malaria:
view in the laboratory building
h was the nerve center of the
paign

RONT-LINE TRENCHES in the war
gainst gambiae were shallow
hes and pools. Larvicides were
yed on every breeding place to
spread

AN INSPECTOR applying Paris
green to a windmill-fed irriga-
canal

A GASOLINE-POWERED compres-
sor for ridding houses of the
squito

6 THE SPRAYER in operation in a typical rural home. With 12,000 square miles infested and well-watered valleys not far away, gambiae threatened to spread beyond control through South, Central, and even to North America

7 "DEATH to the last pair." Catching mosquitoes on a square umbrella

8-9 THE MOSQUITO FRONTIER: a station for disinsectizing vehicles

10 EVEN a native raft can carry larvae in its cask. But by late 1940, no gambiae were found in all Brazil

6

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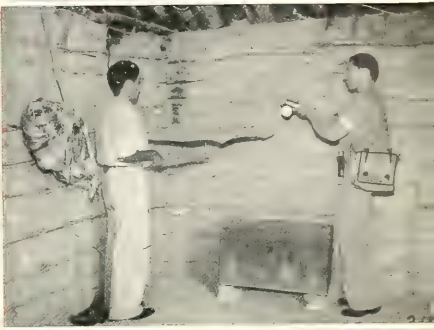

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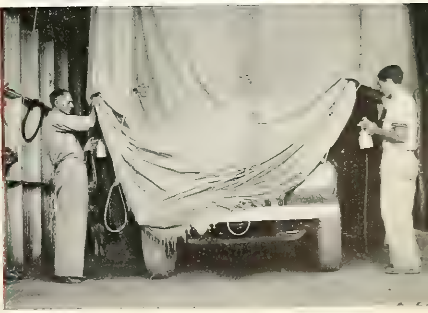


10

[illegible] natural conditions unfriendly to the invader.

[illegible] compelled to undertake control of this mosquito in order to maintain an efficient staff for its own work.

[illegible] of severe dry seasons seemed to check the invasion, and then, with the return of normal rainfall, the onward flight started again. Within a few years, severe epidemics of gambiae-carried malaria had occurred in [illegible] In the Jaguaribe Valley alone there were over 50,000 cases of malaria in 1938. Over 90% of the population was affected, with mortality in certain districts [illegible] the epidemic that, in some parts, crops were not planted and salt production was greatly reduced because of lack of labor. It was estimated that as a result of the ravages of this mosquito nearly every person in these affected areas would be on government relief in 1939.

George E. Vincent, formerly President of the Rockefeller Foundation, wrote in his report for 1928, "It has been said that a good malaria fighter must 'learn to think like a mosquito.' He must ask: which of many kinds of anopheline mosquitoes shall I try to imagine myself? How far is it possible to fly? When and where is food to be had? Which blood is to be preferred, human or animal? How can one get into a screened house? Where shall one rest after a good meal? Where is the best place to deposit eggs? Is the water of the right kind and temperature? Is it stagnant or flowing?'"

Fortunately, through the work of the Foundation's staff and others in Africa, much is known about the gambiae. It breeds prolifically and rapidly, requiring only seven or eight days to develop from egg to adult, a fact that makes breeding possible in very temporary water collections. It has variable breeding habits, but seems to prefer stagnant, sunlit water. Like other malaria-carrying mosquitoes, it of course has to sting a person infected with the disease to be dangerous. But it has a high infection rate. During the outbreak in the city of Natal in 1930, almost two-thirds of the gambiae caught and examined were found to be infected with malaria, a rate higher than anything hitherto known in the Americas. This mosquito seems to prefer human to animal blood, and it usually bites indoors, not outdoors. Fairly reliable records indicate that the insect can fly a distance of more than three miles.

Late in 1938 representatives of the Brazilian health service and the Rockefeller Foundation staff investigated the infected area in North Brazil. What they found confirmed the seriousness of the situation. Once the gambiae gets into a river valley it spreads up the valley unless blocked at some point by natural or artificial barriers.

With the assistance of the Rockefeller Foundation an anti-gambiae service was organized. As there was not sufficient time to develop a separate agency, this was organized as a part of the existing local yellow fever service. This affiliation made available the wide experience of a well trained group of men accustomed to working under discipline. Except for the distribution of quinine by field personnel working in infested districts, this service did not include responsibility for medical care of the sick in dispensaries or otherwise. The intended purpose of the service was to confine the gambiae to the relatively arid areas it occupied, and possibly even to exterminate it there. If, on the other hand, the mosquito should break through to the well-watered Parnahyba and São Francisco River Valleys, it was realized that further efforts might fail to prevent its spread to a large part of South, Central, and perhaps even North America. The insect was already nearly half way to the Parnahyba Valley.

An appropriation of $100,000 was set aside by the Rockefeller Foundation for expenditure on the problem in 1939. The Government of Brazil also earmarked substantial sums.

The dreaded gambiae had now spread over 300 miles to the west and infested an area of 12,000 square miles. It had often traveled by boat from point to point along the shore. The interior of the State of Rio Grande do Norte in this section is extremely arid at all times, and the mosquito failed to penetrate far inland, but it succeeded in breeding its way along the flat alluvial shelf. This strip is so narrow in several places that the work of 15 or 20 men would have been enough to halt the invasion at any time during the early years.

That gambiae did not spread southward from Natal during all this time is a piece of good fortune not easy to explain. True, the prevailing winds are in the opposite direction, but the mosquito might have made progress against the wind in cars, boats, and trains. Until recently no attempt was made to fumigate them.

Aroused by the calamitous epidemics that occurred in 1938, the national government of Brazil in 1939 increased its appropriation from a quarter to a half a million dollars. Plans for 1940 provided for a further increase, and in that year the Rockefeller Foundation set aside $230,000. The additional economic loss caused directly or indirectly by the offspring of the original gambiae, as well as the human suffering, are difficult to estimate.

The first results in 1939 were frankly disappointing. The counterattack coincided with the beginning of the rainy season, during which the gambiae advances by leaps and bounds, and this, together with a shortage in trained personnel, prevented any early results. As anticipated, widespread epidemics of malaria occurred, and during the first few months of the Service some 114,000 persons were treated for the disease. During these early months the only visible consequence was a lowering of mortality from malaria through medication of acute cases.

By the beginning of July, however, a staff of over 2000 doctors, technicians, scouts, inspectors, guards, and trained laborers was available, and even though the rainy season was unusually prolonged appreciable results were obtained. Further spread of gambiae in the frontier districts was minimized, and the incidence of the mosquito was reduced in certain heavily infested sections to a point where careful surveys repeatedly failed to reveal the presence of either larvae or adults.

The campaign was revealing that both climate and physical geography were indispensable allies. Gambiae is a mosquito which breeds mainly in residual rain-water pools, shallow, open to the sun and without vegetation. It does not lay its eggs in permanent or deep water, in running, salty or shaded water or in water supporting aquatic vegetation. On the other hand, it takes advantage of every little depression in the ground, such as wheel tracks or hoofprints, no matter how shallow or small, which can present a water surface for eight or nine days. During the rainy season, with its almost daily showers, gambiae becomes a formidable antagonist. But the rainy season is restricted to four months out of the twelve, from February through May.

For eight months in the year, the heat of the tropical sun, the strong continuous trade winds, and the low humidity combine to dry up all shallow surface waters and to make life precarious and of short duration for the gambiae. Potential breeding places are reduced to disconnected pools in the beds of the large rivers, none of which maintains a flow in summer. Most of the higher rolling country back from the coast is practically non-infectible by gambiae. Its arid, stony soil supports a scrub vegetation composed of a resistant, thorny bush mingled with cactus. The region is without water for larvae, and without shelter for gambiae adults.

The plans of the campaign against gambiae were like the plans of an army on defense. The frontiers of the infested region were defined by fumigation posts on all the outgoing roads. These were the forts of this new kind of Maginot Line. Every automobile and train leaving the infested area had to be stopped, inspected, and fumigated. A maritime service was organized at points along the coast to disinfect every boat or plane bound for clean ports.

A 10-mile zone beyond the gambiae's farthest limit of advance was to be kept non-infectible, which from the mosquito's point of view represents the "scorched earth" policy. Within this zone, as well as within the area already infected, all breeding places of the mosquito had to be eliminated or treated with Paris green or other larvicide. The whole region was mapped from the air so that no pools, ponds, or other collections of water would be overlooked. The adult mosquitoes were sought and killed in houses with insecticide sprays to diminish the chances of their laying eggs and thus perpetuating the havoc. It was a war in a very real and grim sense. Unlike other types of war, its purpose was the preservation of human life.

By December, 1939, the invader had been pushed back to its central strongholds in the main river valleys and on the narrow coastal shelf. If it could be held within those limits during the wet season of 1940, those in charge of the campaign began to hope that it might eventually be eradicated from the entire region. This, of course, would mean extermination of the last surviving pair. And as in all campaigns, accidents might determine the issue. Thus in one case the mosquito was transported many miles into previously uninfected territory in an old automobile which followed an improvised wagon road through the jungle and thus avoided the fumigation post on the main thoroughfare. In another case a wedge was driven into the defense line against the spread of the disease when a small fishing boat carried the mosquito up the coast. If the war was to be won it was realized that victory would come only through continued vigilance. The wet season of 1940 would be the test.

At this critical stage in the campaign a concerted effort was made under the direction of Dr. Fred L. Soper, representative of the Rockefeller Foundation in Brazil, to narrow still further the boundaries of the insect's domain. This intensive attack had dramatic results. During the critical wet season the mosquito was pushed back on all sides, so that by the beginning of the dry season it had been practically restricted to the lower Jaguaribe Valley. This made possible the concentration in this area of a large number of workers for the final onslaught beginning in July.

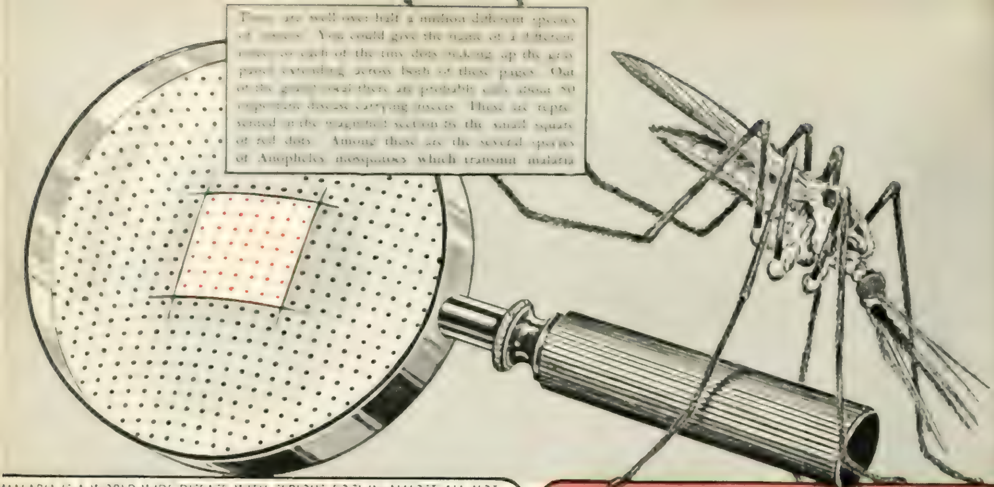
Toward the end of the year it was possible to report that no larvae or adults had been found in the lower Jaguaribe Valley since the first week in September. A small additional focus lying some 35 or 40 miles beyond the known infested area was discovered in October, but it yielded to attack and was apparently clean by the middle of November. And, marvelous to relate, during the last 47 days of 1940 no evidence of gambiae was found in all Brazil.

Even in areas of earlier infestation where control measures have been progressively discontinued, the unwanted visitor from Africa has not been seen. In the Icó field laboratory alone, some two million anopheline larvae were examined microscopically during the last eight months of 1940 from areas where control measures had been suspended, and not one of these was a gambiae. Those directing the campaign, therefore, no longer consider it rash to speak of the eradication of gambiae in Brazil. If by chance isolated foci should appear, it could still be said that the critical phase of this campaign is over.

The battle would seem to have been won—but at what labor, cost, and suffering. More than two million dollars was spent on the actual campaign before the gambiae mosquitoes apparently gave up their intention of establishing themselves in the Western Hemisphere.

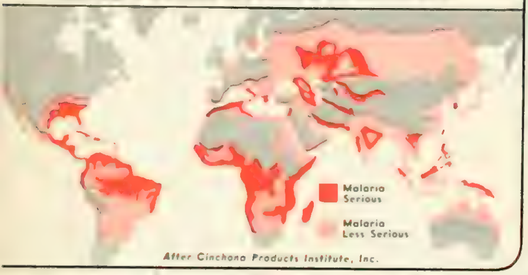
Airplanes are crossing the South Atlantic with increasing frequency, but commercial planes are now carefully fumigated, both after leaving Africa and before discharging their passengers in Brazil. In October, 1941, a "threatened invasion" is known to have been forestalled. A dead female gambiae was discovered after fumigation in a plane arriving in Brazil. Two more were found last January. The original infestation, with all its subsequent miseries, could readily have been started by a single fertilized female. Truly the price of liberty, as far as this malaria-carrying mosquito is concerned, is eternal vigilance.

Through the courtesy of the author this report will appear as one section of a comprehensive booklet entitled *Insects, Ticks, and Human Diseases* soon to be published by Frank E. Lutz and C. H. Curran under the imprint of the American Museum of Natural History.

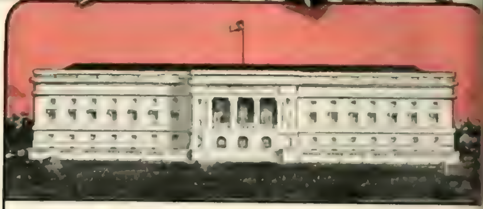


There are well over half a million different species of insects. You could give the name of a different insect to each of the tiny dots making up the gray panel extending across both of these pages. Out of the grand total there are probably only about 50 important disease-carrying insects. These are represented in the magnified section by the small square of red dots. Among these are the several species of Anopheles mosquitoes which transmit malaria

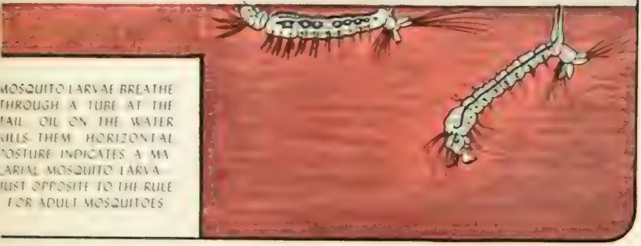
MALARIA IS A WORLD WIDE DISEASE WITH SERIOUS FOCI IN ALMOST ALL HOT COUNTRIES. IT IS ENDEMIC IN 17 STATES IN THE UNITED STATES



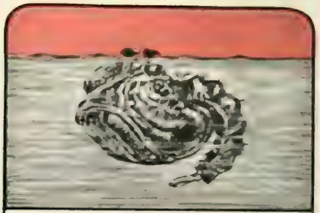
After Cinchona Products Institute, Inc.



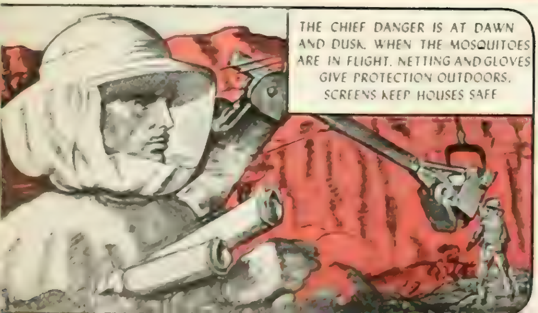
IT WAS ONCE ESTIMATED THAT THE MONEY LOST EACH YEAR THROUGH MALARIA IN THE UNITED STATES WAS TWO AND ONE HALF TIMES THE ANNUAL OUTPUT OF THE PHILADELPHIA MINT



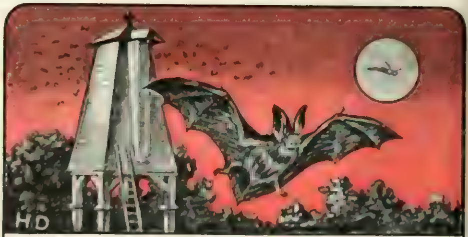
MOSQUITO LARVAE BREATHE THROUGH A TUBE AT THE TAIL. OIL ON THE WATER KILLS THEM. HORIZONTAL POSTURE INDICATES A MALARIAL MOSQUITO LARVA—JUST OPPOSITE TO THE RULE FOR ADULT MOSQUITOES



THE PUPA BREATHES THROUGH TWO FUNNEL-SHAPED ORGANS AND CAN ALSO BE KILLED BY OIL



THE CHIEF DANGER IS AT DAWN AND DUSK, WHEN THE MOSQUITOES ARE IN FLIGHT. NETTING AND GLOVES GIVE PROTECTION OUTDOORS. SCREENS KEEP HOUSES SAFE



BAT ROOSTS WERE ONCE BUILT TO ATTRACT BATS IN THE HOPE THEY WOULD REDUCE THE POPULATION OF MALARIAL MOSQUITOES, BUT WITHOUT REAL SUCCESS. DRAGONFLIES, HOWEVER, ARE CALLED MOSQUITO HAWKS AND DO CURB MALARIA

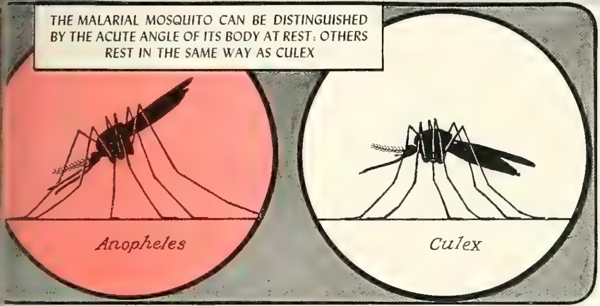
Control of
MALARIA

Malaria has a higher sickness and death rate than any other disease. Over 800 million persons suffer with it, and more than 3½ million die of it annually. But control of the disease through scientific methods of prevention and cure is possible and has been accomplished in many parts of the world

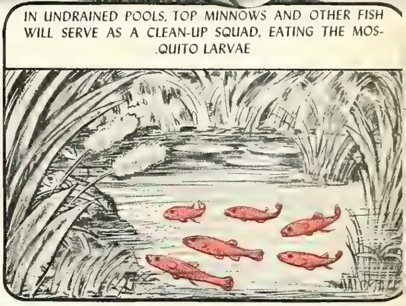
Drawn by HARRY R. DAUGHERTY

from exhibits in the American Museum of Natural History

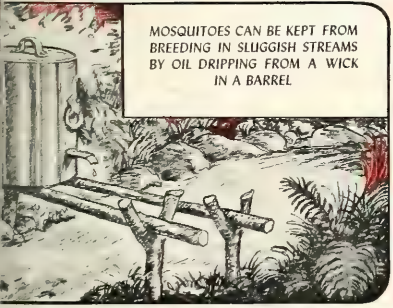
THE MALARIAL MOSQUITO CAN BE DISTINGUISHED BY THE ACUTE ANGLE OF ITS BODY AT REST: OTHERS REST IN THE SAME WAY AS CULEX



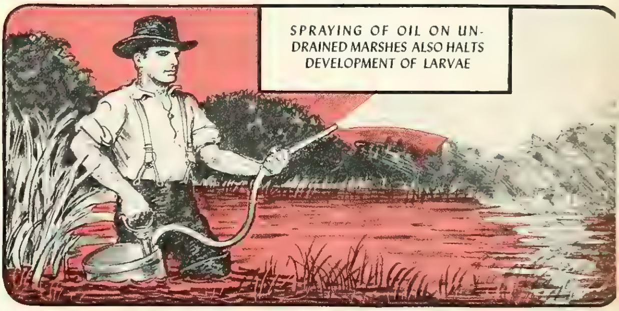
IN UNDRAINED POOLS, TOP MINNOWS AND OTHER FISH WILL SERVE AS A CLEAN-UP SQUAD, EATING THE MOSQUITO LARVAE



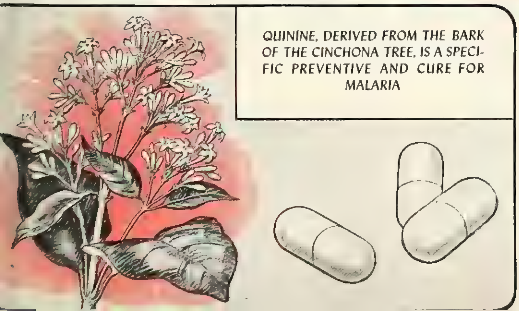
MOSQUITOES CAN BE KEPT FROM BREEDING IN SLUGGISH STREAMS BY OIL DRIPPING FROM A WICK IN A BARREL



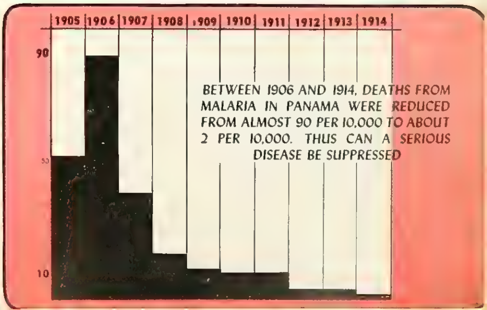
SPRAYING OF OIL ON UNDRAINED MARSHES ALSO HALTS DEVELOPMENT OF LARVAE



QUININE, DERIVED FROM THE BARK OF THE CINCHONA TREE, IS A SPECIFIC PREVENTIVE AND CURE FOR MALARIA



BETWEEN 1906 AND 1914, DEATHS FROM MALARIA IN PANAMA WERE REDUCED FROM ALMOST 90 PER 10,000 TO ABOUT 2 PER 10,000. THUS CAN A SERIOUS DISEASE BE SUPPRESSED



QUININE

By Anna Koffler

W[illegible] But around 90 per cent of the world supply of quinine is produced in the Netherlands East Indies, and the thrust of Japan into the enormous riches of those islands means also a drive to the world-center of the cinchona (pronounced sin-kon'a) trees, from whose bark the alkaloid quinine is obtained.

The cinchona trees themselves, however, are not native to Java, where now the big cinchona planta-[illegible] South America. They are native to the mountain forests of Bolivia, Peru, and Ecuador, where they flourish chiefly at altitudes [illegible] species of cinchona have been identified, but only about a dozen of them are economically important, and only four are used medicinally. The so-called *Cinchona officin*-[illegible] bark [illegible] *Cinchona calisaya* and *Cinchona succirubra* provide the yellow [illegible] respectively, and *Cinchona ledgeriana* is by far the finest tree, with a high yield of quinine.

Some believe that the Indians had probably discovered the marvelous properties of this drug before the Europeans came; others do not. In 1630 Francisco Lopez of Canizares, Corregidor of Loxa in southern Peru, is said to have been stricken with malaria and to have been cured by an old Indian medicine man who administered cinchona bark. The first unmistakable reference to cinchona, however, was in 1633. And it is now definitely known that a knowledge of quinine had reached Europe by 1643, for in that year we find mention of it in Belgian literature. Nobody knows how cinchona bark got to Europe; and concerning both its name and its voyage across the Atlantic, the record has become confused. The Countess of Chinchon, wife of a Spanish viceroy of Peru, figures in an explanation commonly given. She is said to have become ill with intermittent fever and to have been cured with cinchona bark, whereupon she took a quantity of it with her back to Spain. But the woman for whom cinchona bark is supposed to have been named never even went to South America. And the second wife of the Count of Chinchon, who might be an alternative possibility, is shown on excellent evidence to have scarcely been sick a day in her life and to have died in Cartagena without returning to Europe.*

What we do know is that the Jesuits, influential in the 17th century Spanish Court, became interested in the bark and later acquired a monopoly for its distribution. They popularized it to such an extent that it became known as *pulvis Jesuiticus*—the Jesuit's powder, under which name cinchona bark is known even today. The name quinine itself goes back to the Incas, who called it in their language *quinquina*, which simply means bark. In the seventeenth century prices which make us shudder were paid for quinine. For instance, the English physician Sir Robert Talbor, [illegible] was paid [illegible] and was made a nobleman by Louis XIV for curing the Dauphin from intermittent fever and providing a small supply of cinchona bark. The present price of quinine is 69¢ an ounce.

But though the bark itself had become so popular, the plant which yielded it remained botanically unidentified until 1753, when the French Government sent a scientific expedition to South America. Two of its members, Joseph de Jussieu and La Condamine, discovered the trees and managed to collect many young plants. But neither of them could preserve what they had collected under indescribable hardships and toils. Jussieu remained fifteen years in South America and was able to make a fine collection of cinchona seed and young plants, but on the evening before his departure he was robbed of all the fruits of his labor. Because of this event, which had deprived him of his life's work, he became insane. La Condamine's collection, on the other hand, was lost during transportation down the Amazon River. He managed, nevertheless, to send a sample to the famous Swedish botanist, Linnaeus, who named the genus in honor of the Countess of Chinchon.

It took another century for a species of cinchona, the so-called *Cinchona calisaya*, to be raised in a European garden, in the Jardins des Plantes in Paris.

In the course of time the demand for the cinchona bark became so great that there was danger of the future supply being entirely damaged by the reckless stripping of the trees. The South American forests were for a great part simply destroyed, the trees being felled for their bark. Hand in hand with the threatening scarcity went an increase in price. In the beginning of the nineteenth century the incredible sum of 112 English pounds was paid for a kilo of quinine! The high price and the situation in South America stimulated many vain attempts to find a natural or synthetic substitute for quinine. But as no practical results could be obtained and the situation became more urgent from day to day—especially as the scourge of malaria raged over all tropical countries and took millions of victims—the idea arose to create cinchona reservations in other countries, where soil and climatic conditions were suited. Suggestions were made to establish cinchona plantations in certain districts of India and Ceylon and on the isle of Java, districts similar in climate to the primary South American regions. The first experiments failed. It

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* [illegible]

An old South American remedy steps into the world struggle

took tremendous efforts, unceasing energy, determination, courage, and patience to establish successful plantations.

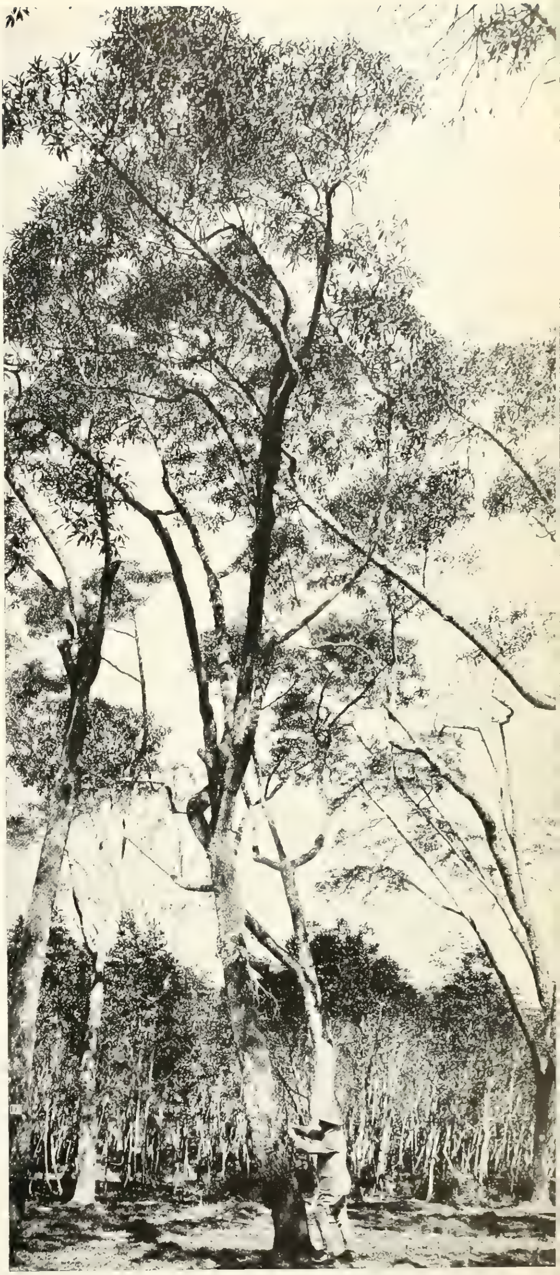
The main concern in the beginning was how and where to obtain the necessary seed and young plants. In 1852 Hasskarl was sent by the Dutch Government to South America, and in 1859 Sir Clements R. Markham was entrusted by the English Government with the difficult task of procuring seeds. In 1853 Hasskarl found the first cinchona tree at Monobamba, Bolivia, and soon afterward sent seed and plants to Europe. Though the seed arrived, the plants withered away during the long journey. Yet Hasskarl did not give up. Encountering innumerable adventures, he succeeded under great hardships and risks in gathering a second collection, which was sent directly to Buitenzorg in Java. When the boxes arrived and were opened, only 75 plants out of the 500 had survived. These were brought to Tjibodas, at an elevation of about 2000 feet, where in the meantime the seed previously collected arrived. The seed was sown and the 75 plants were planted.

These seeds were of the *Cinchona officinalis* and *calisaya,* which yield the crown bark and the yellow

➤ WHILE VITAL TO THE HEALTH of armed forces throughout most of the tropics, quinine is produced chiefly in regions now occupied by the Japanese. At right: the original trees imported to the Netherlands East Indies from their South American home in 1866

▼ AN OUNCE of seeds will produce 25,000 plants, but climate and soil must be just right, and the bark does not reach its maximum yield for four years

Netherlands Information Bureau Photos



▲ Under a free people, this native of the Netherlands East Indies works to live; under totalitarian rule he will live to work. His skillful hands are grafting two species of cinchona in order to produce a sturdier plant and to obtain a higher quinine yield

◄ High grade grafting after five months results in the production of superior plants like these, at one of the Netherlands East Indies experimental stations

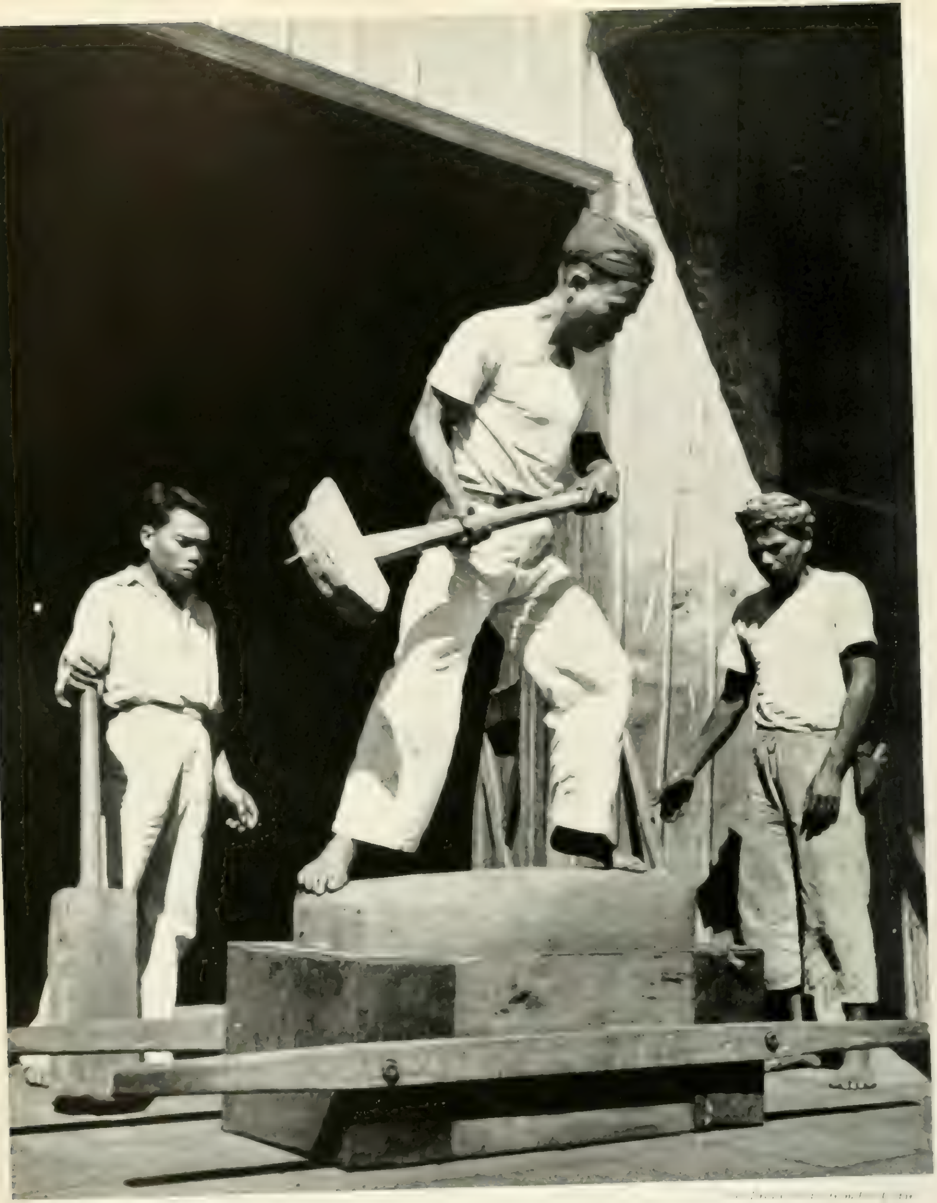
▼ Two-year-olds wearing the delicate pink, white, and yellow blossoms of the lovely flowering cinchonas

When six years old, the plantation is thinned out. Below, natives are stripping bark from uprooted trees

▲ IN THE REGION that produces 95% of the world's quinine, men chop the trees down and women debark them. The Dutch stopped shipping quinine to Axis powers with the invasion of Holland, but now Japan controls the source

▼ AFTER malleting the bark, strips are placed in the sun to dry and are then taken to enormous indoor ovens to complete the drying

Deé Bredin Photos from Black Star



▲ SLEDGE HAMMER and footwork mold the powdered cinchona bark into tight 100-kilo bags for shipment from plantation to factory. There it is mixed with water and oil and subjected to a distillation process which leaves the crude quinine as a sediment

➤ SECOND in importance to ammunition is quinine to the Allied soldiers in tropical regions heavily infested with malaria. From stocks on hand or from plantations developed in war-free lands must come the portion that will rest in the pack of every tropical soldier bark of commerce. But it was a merchant by the name of Ledger who, in 1865, advised by his native servant, Manuel Incra Mamani, discovered also in Bolivia the seeds of the finest cinchona tree, which has been called in his honor, *Cinchona ledgeriana*. Today *Cinchona ledgeriana* is mostly grafted upon the hardier *Cinchona succirubra*, from which comes the red bark of commerce. But fate has dealt unhappily with many men throughout the history of quinine. Ledger's faithful servant, who had led Ledger to the finest seeds, was arrested during a second expedition by the Corregidor of Coroico in Bolivia. He died in misery in jail, and the world, and even those who usually cherish the names of men, have forgotten him. It would seem more just if one species of cinchona bore the name of Mamani.

Once the seeds were obtained, there were many problems to be worked out as to the right methods of growing the trees and of collecting the bark. In the course of time it has been found that although the medicinal species thrive where cool nights prevail, they will not stand frost. After unceasing work, the Dutch succeeded in raising the greatest cinchona plantations of the world.

The blossoms of the cinchonas are of very delicate pinkish, white, and yellow shades; they grow in rich tufts, and from them come the seeds in equal abundance. The seeds are methodically collected in white linen bags—easily one pound of seeds can be collected during one morning by shaking the fruiting branches—and are sorted by native girls on glass plates which are electrically illuminated from below. Although the seeds keep their germinative power for several months, they are not collected long before it is planned to sow them. One ounce of seed will produce some 25,000 plants. The seeding usually takes place after the spring monsoons, the seeds being strewn by hand in open beds on specially prepared soil. After six weeks they germinate, and after about six months, when they are one foot high, *Cinchona ledgeriana* is grafted upon *Cinchona succirubra*. Two or three months later they are transplanted to the nurseries, and later on to their final positions.

Many attempts have been made to increase the alkaloidal content of the bark. It has been found that the bark is richest in alkaloids when the tree is about four years old, and that the bark of the roots is even richer in alkaloids than that of the stem.

The most primitive form of collecting the bark is the so-called "uprooting," which was formerly the general practice and which has nearly destroyed the South American reserves. When about ten to twelve years old and still highly productive, the tree is felled, and the bark is stripped from its stems, branches, and roots.

"Coppicing," or as the Dutch call it *op stomp kapping*, is another method which has been tried. In this, the trunk is cut a few inches from the ground. Shoots then spring up from the stumps, of which two are left to form the second "coppice" in the course of time.

A third method, which is called "scraping" or "shaving," is based upon the discovery that the second growth of the bark is, on the average, 20 to 30 per cent richer in alkaloids than the first. Thus the bark is simply scraped off with special bamboo or horn knives as near to the cambium or life-giving layer as possible without injuring it.

It had long been observed that the side of the tree that was away from the sun was richer in alkaloids, hence the process known as "mossing." It was McIvor in the Nilgeri Hills in India who first experimented with this method. He covered the stems of the cinchonas with a thick layer of moss, and the results thus obtained surpassed all expectations. The yield of the alkaloids was often three or more times as much.

From these experiments a new method was developed. Long strips of the bark were removed lengthwise and the exposed space covered with moss. When the bark renewed itself, other strips were removed, and so on, until the whole of the bark was renewed. This renewed bark is rich in alkaloids, and in the course of time is ready for removal. This process can be continued over and over during the normal life of the tree, but it requires skilled laborers, and the basic method of uprooting the tree remains the usual one throughout the East Indian plantations.

The bark contains about 70 per cent water and has to be dried before it is suitable for use. It is either sun-dried or brought to specially prepared drying sheds, where it goes through an oven-drying process. Then the bark, which is very bitter, is shipped in bales of 200 pounds to the quinine factories. Much of the bark often comes to the factory as reddish-brown dust, resembling cinnamon. When all the bark has been pulverized, the distillation process begins. The powder is mixed with water and boiled in great vats to which a kind of kerosene is added. The quinine is taken up by the oil, which is then led to other vats where sulphuric acid is added. The acid removes the oil and leaves the crude quinine as a sediment.

[illegible] Long before Pearl Harbor, indeed [illegible] of the Netherlands [illegible] bark to the Axis powers; therefore the goods were delivered only to English, American, or Dutch factories.

About 30 distinct alkaloids have been obtained from the bark, of which quinine is by far the most important. Besides quinine only three others form salts that are officially recognized; quinidine, cinchonine, and cinchonidine. It was the great achievement of several medical authorities, and especially Professor Binz in Bonn, to show that quinine is poisonous to certain protozoa, including malaria parasites. The disease of malaria is caused by the presence of minute protozoa which are injected into man by the sting of the anopheles mosquitoes. They pass their asexual stage of life in the blood of man. There they produce fresh broods with some male and female forms, and each output of a new brood into the blood is accompanied by the symptoms of the malarial attack. Thus man becomes the intermediate host of the malaria parasite, which is again acquired by the female mosquito when the insect bites a person afflicted with malaria. The sexual cycle takes place in the female anopheles mosquito.

Many experiments have shown that quinine is able to kill or inhibit the parasites. Each dose of quinine, taken at the right time, decreases them until they are often totally annihilated. Extensive information as to the doses required was obtained during the last World War. But although wonderful results in the cure of malaria have been obtained with the help of quinine, it is not yet known exactly why and how quinine works in the human organism. The price for quinine went up to $1.50 an ounce during the last World War.

Malaria has unfortunately a very wide range. It occurs in all tropical countries and extensively in subtropical ones. Particularly after rainy seasons, when there have been plenty of breeding opportunities for the mosquitoes, is the problem serious. Malaria is endemic in 17 states in the United States.

What can be done to suppress this scourge of mankind has been demonstrated by the U. S. Government in the Panama Canal Zone, where malaria has been almost completely exterminated in areas formerly seriously infested with it. The breeding places of the anopheles mosquito are destroyed by covering the surface of the pools with oil and strictly insisting that every water container, be it a discarded can or a flower pot in the garden, be emptied of water. Outside of the Canal Zone malaria is a very serious problem in Panama.

Many more persons fall victim to malaria than we usually imagine. The quinine research office in Amsterdam reported that in the year 1923 there were 1,300,000 deaths from endemic malaria in India alone. And a report of the Friends' Russian Famine Relief from the same year states that 60 to 70 per cent of the whole population in South-East Russia were stricken with malaria. The Committee of Hygiene of the League of Nations sent a special Malaria Commission in 1924 to study the organization and cost of a campaign against malaria in Yugoslavia, Bulgaria, Russia, and Italy. All these countries at that time suffered from malaria.

In the meantime much has been done to combat the disease, but much remains to be done. In the years past the price of quinine often remained too high to make its distribution possible on such a scale that would reach all in need of it. When this war is over everything should be done to avoid a return to this condition.

Botanically, the genus Cinchona belongs to the family of the Rubiaceae, the madder family. The pulverized roots of the madder were generally used as a dye to achieve brown and purple colors, before the invention of synthetic dyes.

As there are families from which come many distinguished men, thus there are plant families whose members are remarkable. To the madder family belong not only cinchona and madder, but also coffee, ipecac, and the gardenia plant. It is surprising to many that this versatile family should produce on the one hand tropical giant trees reaching a height of over 80 feet, and on the other tender herbs only one to two inches high.

Few plants have played such an important role in the history of mankind as cinchona. This remarkable bark has become a key to world-power, has helped to preserve the white civilization in the tropics, has saved innumerable lives and become the economic basis for the existence of thousands and thousands.

More and more details about the action of quinine come to light. Quinidine, one of the other alkaloids derived from the cinchona bark, is used in forms of hyperactivity of the heart. As early as 1872 the renowned Viennese clinician, Oppolzer, said in his lectures on the treatment of internal disease: "The best and most powerful factors in dealing with heart patients are three: rest, digitalis, and quinine."

Not only in medicine, but also in cosmetics and industry, quinine plays a part.

It is of interest that among the many plants used against intermittent fever, the bark of the dogwood has figured rather prominently, often directly as a substitute for quinine. The bark of this familiar small tree of eastern and central America produces a decoction that was known to all the Eastern Indian tribes; and the early settlers, who often suffered from malaria, readily availed themselves of this native remedy. The bark of dogwood became very popular during the Civil War, when South American drugs could not be obtained. But its effect cannot be compared with that of the cinchona bark, since it is only a slightly astringent tonic.

The world demand for quinine reached millions of kilos before the outbreak of this war. The United States imported 4,038,541 pounds of cinchona in the first 9 months of 1931. In time the benefit this remarkable product of nature bestows on mankind may be achieved by synthetic drugs. Atabrine has already been found of great value in the treatment of malaria. But the use of quinine is traditional throughout the areas of the world where malaria is a threat, and the ease of administering it on a large scale makes it especially adaptable for use among our expeditionary forces. Thus the supplies of quinine which the country has stored up will play an important part in the fight for freedom.

World Migrations

By H. L. SHAPIRO

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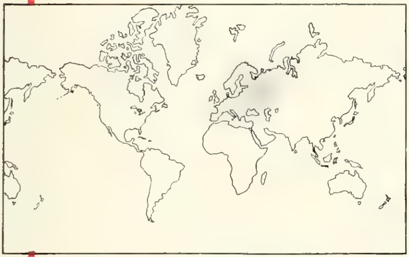
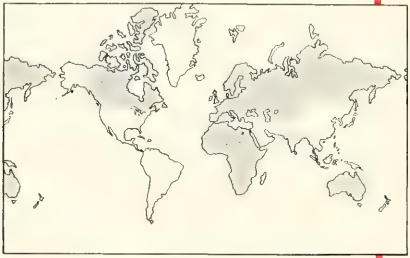
In four and a half centuries, the extent of European empire has spread from a mere 7% of the inhabited land area of the globe to approximately 63%. In addition, most of North and South America were under European control for a time but later achieved independence. Thus at one time or another 85% of the world has been under European rule. With the status of many countries, like India, hanging in the balance, the question arises: Is the world moving toward unification or autonomy?



1492



1940

AS FAR back as we can go in time, migrations have played a significant part in human affairs. That this should be so is, when we come to think about it, inevitable. For not only does man, like all other ambulatory creatures, escape from intolerable conditions by flight but he has by virtue of his more complex social and psychological organization a greater capacity for discontent, fancied or real, than any other animal. Thus mankind, living until recently in a world but sparsely occupied by his fellows, has ever been ready and able to push into new areas in the hope of bettering his condition or because he has had no choice but to move.

Of all the mass movements that have taken place in the past, none approach in magnitude of numbers or in area involved the post-Columbian migrations from Europe. The Mongol streams of the thirteenth century, although comparable in the distances traversed, were confined to a relatively small number of conquerors. Similarly, the historically significant Völkerwanderung of the early Christian era shrinks to the level of a local upheaval when compared to the vast eruption of peoples that occurred throughout the world between 1492 and the present day.

Not only were the post-Columbian readjustments of population on a scale hitherto unknown, but the character of the movement and its origins were much more complex and varied than those of previous migrations. It is impossible in a limited space to do justice to the history of this migration, but some idea [illegible] magnitude and ramifications [illegible] emerges when we recall that the period began in the Renaissance and reached its climax in the present industrial age. During much of this time persecution for political, religious, racial, and economic reasons in Europe were [illegible] whole-sale migrations. Moreover, the complexity of the phenomenon was greatly increased by the untold number of African natives added to this stream of humanity against their will, and by the numerous Chinese, Hindus, Japanese, and other Asiatics also drawn into these currents of population adjustment that followed on the increasing integration of the world.

So varied a movement cannot be broken up into mutually exclusive categories or phases, but it is possible to discern in this vast population adjustment two contrasting, although frequently overlapping, forces. The first and older was the conquering and [illegible] phase of European expansion. It involved, at most, relatively few men and it began from southwestern Europe. The second factor was largely a colonizing and settling activity which began later and finally affected an enormous number of people from all parts of the world, but especially Europe. The first of these aspects created the great empires and extended the political and economic control of Europe. It engulfed practically all of Africa, it managed to exert control over a large part of Asia and for a time at least held sovereignty over all the Americas. The colonizing impulse was more restricted, finding its major resolution in the New World and in the sparsely inhabited areas of the Old World that were suitable for settlement.

New worlds

The accompanying maps were designed to illustrate this movement of world population in the 450 years since the discovery of America. This beginning date was selected because it symbolizes the sudden expansion of the geographic horizon that occurred in Europe at about that time. Although 1492 conventionally recalls the discovery of the New World, it also represents an era rich in the discovery of hitherto unknown parts of the Old World. As our school histories remind us, Columbus stumbled on the Western Hemisphere while seeking to find the eastern regions of the Old World, and for some time it was thought that the American "Indies" were in fact the East Indies. Contemporary with the exploration of American shores, European navigators were rounding Africa, sailing into the Indian Ocean, opening up trade with the East Indies and China, and traversing the wide reaches of the Pacific. These Old World discoveries were as exciting as the first glimpses of the New World. Indeed to the European of that day a distinction between the discoveries in the New World and the Old was scarcely drawn. They were all part of a new world. Only later when cartographers put it down and drew for all to see did the reality of a new hemisphere become common knowledge.

The fascinating new regions disclosed by this era of discovery, especially the evidences of their wealth, stimulated the European imagination to see in them an extraordinary opportunity for enrichment which they were not slow in pressing. Thus almost immediately after the knowledge of the West Indies reached Spain, steps were taken by the Spanish Government to clinch their claim, and adventurous youth eager for wealth and renown flocked to the new colonies. It is significant that these new areas of potential wealth were regarded as private preserves to be plundered by the Spaniards only. Quick to claim their own fictitious rights, the *conquistadores* never seemed to recognize that the natives had any. Although the Spanish ravages upon native culture and wealth have been highlighted by the dramatic destruction of the Aztec and Inca empires, we must not forget that the English and French were frequently as callous of any moral claims other than their own.

Following upon the heels of the Spaniards, all the remaining powers on the western fringe of Europe, the "Atlantic Nations" of Portugal, France, Holland, and England, rushed in to stake out their claims. They, too, were actuated by imperial and commercial ambition and were eager to exploit the new country. In each case some colonization accompanied the politial and commercial expansion. Only among the English did colonization almost from the outset assume an importance equal to purely economic considerations.

Asia and Africa

But if the New World captured the imperial energy of western Europe first, it was not to remain the only theater of that activity. The same nations spread their hegemony over the newly discovered regions of the Old World as well. Spain gained control of the Philippines; Portugal acquired scattered footholds in China, India, and the islands to the south; the Dutch won the East Indies; while England and France fought for India. But colonization in these already densely settled and flourishing areas never amounted to much. The European expansion here was simply one of exploitation and has remained political and economic to the present day. Africa, which was partitioned later, fell largely to the same powers,—with the addition of Italy, Germany, and Belgium as imperial factors consistent with their increased importance in this later epoch. As in the case of southern and eastern Asia, the European control of Africa was merely for economic and political advantages except for South Africa, which proved to be suitable for European settlements on a large scale.

The islands of the Pacific and Australasia also came under the same imperial influences, with Australia, New Zealand, and Hawaii alone becoming significant areas of colonization and settlement.

Only in the northern tier of Asia were the imperial powers of western Europe shut out. The vast expanse from the Urals to the Pacific, inaccessible from the south and blocked by China on the east, remained an easy conquest for Russia, which possessed a natural entry into the region. The sparse and loosely organized settlements of Siberia not only yielded readily to Russian control but also provided little opposition to a vast Russian colonization—a resettlement that has recently been taking place hardly known to the outside world.

Thus, although the European *imperium* has spread over the major portion of the world during the 450 years since Columbus, the actual movement of European populations within this period has been limited to only a fraction of the area at any one time within the control of European powers. The accompanying maps show that the principal fields of European colonization have been North and South America, Asiatic Russia, Australasia, and South Africa. Of these, North America has received the greatest number of settlers.

Latin America

The first colonizers to leave Europe came from Spain, often as adventurers who remained to settle in the New World as landowning overlords. Having established their primary base in the West Indies they soon invaded the mainland, until their hegemony stretched from California and the southern United States to the tip of South America. All this vast region, except for the Portuguese in Brazil, was Spanish. It has been estimated by Rosseeuw St. Hilaire that about three million Spaniards all told emigrated to Latin America during the first 150 years after the discovery. Kuczynski, a leading authority on population, feels however that this is an excessive figure, since not enough shipping was known to have been available during this period to transport such a number.

The settlement of the northern parts of the New World began slowly in the latter part of the sixteenth century, gathering momentum in the following century as the Atlantic coast settlements came into being. The colonists were largely English, with some representation from various other northwest European countries. It is doubtful if the volume of colonists who settled in North America had by the time of the Revolution yet overtaken the Spanish migration in numbers.

During the sixteenth and seventeenth centuries the tide of European migration set firmly toward the New World. In the eighteenth century the flow continued to move in the same direction but with minor diversions toward South Africa and Australia. In the nineteenth century the tide became a flood. Not only were the number of migrants increasing amazingly, but new sources of supply were opening up all over Europe. For the first three centuries Spain, the British Isles, Holland, and France were the principal suppliers of colonists. In the nineteenth century Germany, Ireland, and later Italy, Austria-Hungary, Poland, and Russia, not to mention the smaller countries of Europe, poured forth thousands upon thousands of their natives to join the greatest hegira in the history of man.

Most of this movement followed the lines already established. From 1820 to 1935 Kuczynski estimates that 55 millions entered the Western Hemisphere from Europe alone. By far the major portion of this number settled in the United States. Many, of course, returned after a temporary residence, but the net number of permanent settlers in this period was probably well over 35 millions. During the same century about four millions migrated to Australia and over a million to South Africa.

Control of immigration

The restrictive measures adopted by the United States after the first World War to control immigration has had necessarily a considerable effect upon the size and direction of European emigration, since this country was the largest receiver of European settlers. These barriers have tended to divert many colonists to South America, particularly those from Southern Europe.

On a scale almost comparable to this movement to the New World has been the Russian expansion into the vast Asiatic hinterland. Millions of peasants have been moved to the forests, mines, and fertile plains of Asiatic Russia in a tempo immeasurably increased since the Russian Revolution. The epic of this tremendous migration and the story of the exploitation of the Russian East is in many respects similar to the opening of our own West.

Negroes in The New World

This spilling over the bounds of Europe did not, however, continue without its profound effect upon

MAJOR MOVEMENTS O

Natural History Magazine
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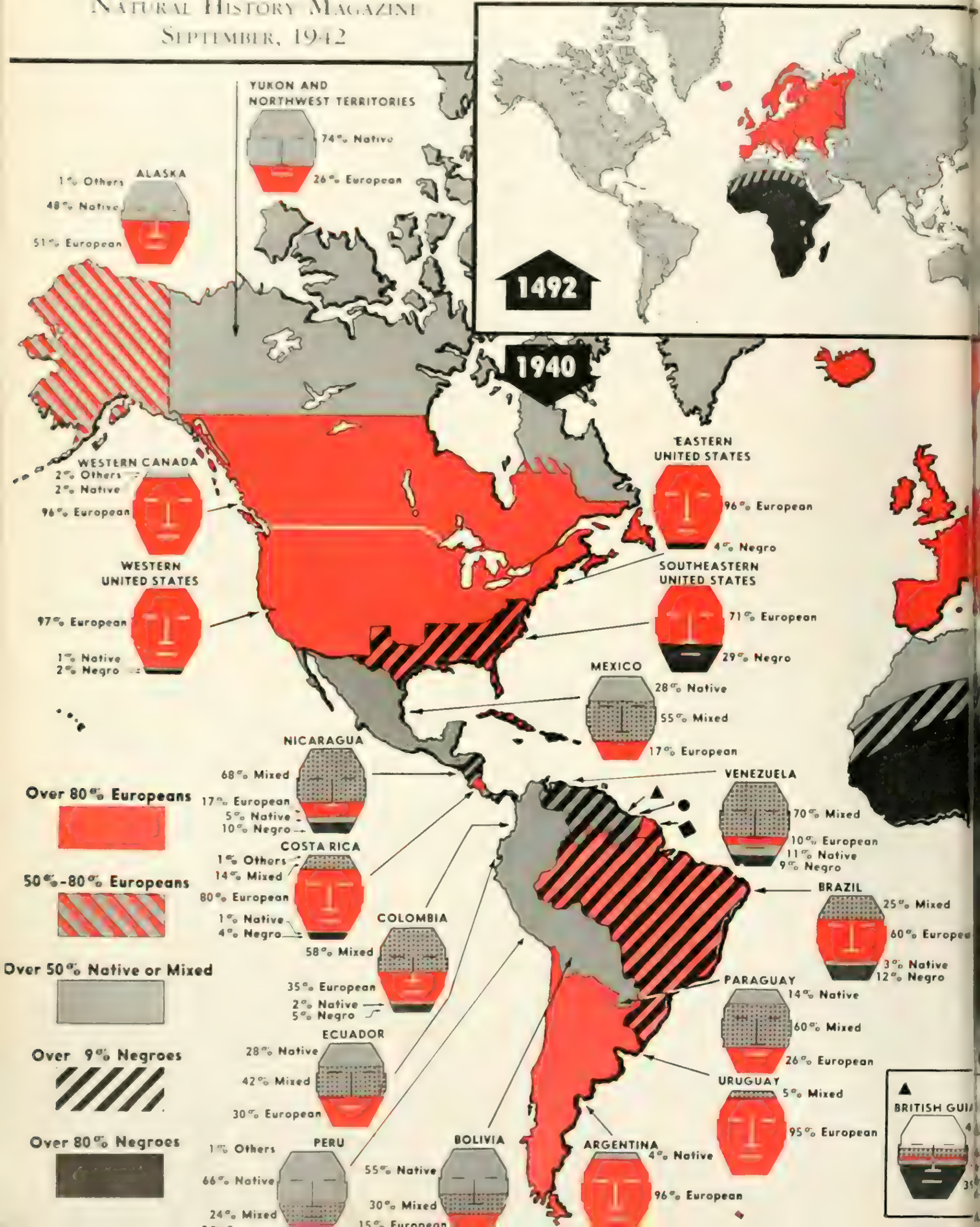
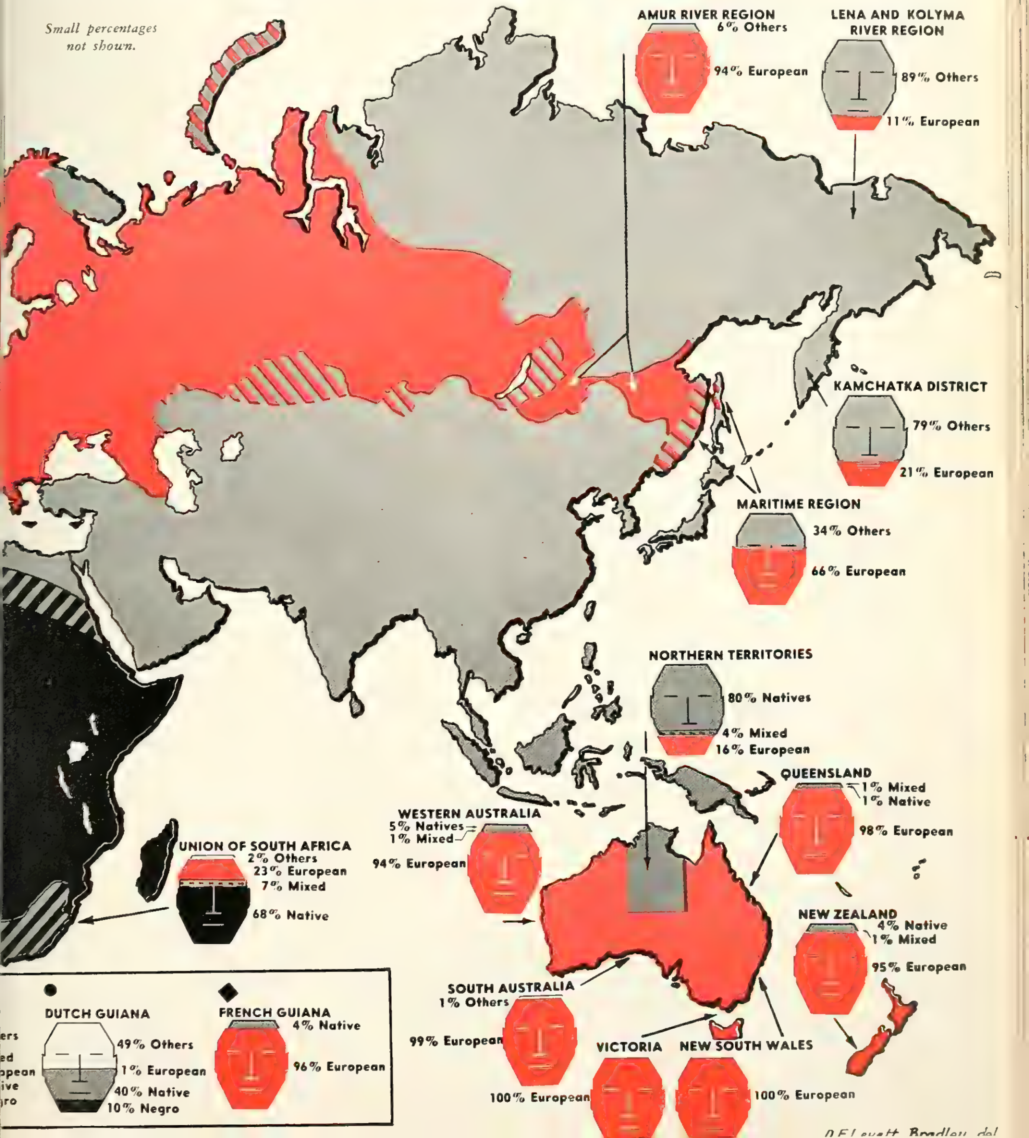

1492
1940
YUKON AND NORTHWEST TERRITORIES
74% Native
26% European
ALASKA
1% Others
48% Native
51% European
WESTERN CANADA
2% Others
2% Native
96% European
WESTERN UNITED STATES
97% European
1% Native
2% Negro
EASTERN UNITED STATES
96% European
4% Negro
SOUTHEASTERN UNITED STATES
71% European
29% Negro
MEXICO
28% Native
55% Mixed
17% European
NICARAGUA
68% Mixed
17% European
5% Native
10% Negro
COSTA RICA
1% Others
14% Mixed
80% European
1% Native
4% Negro
VENEZUELA
70% Mixed
10% European
11% Native
9% Negro
COLOMBIA
58% Mixed
35% European
2% Native
5% Negro
BRAZIL
25% Mixed
60% Europea
3% Native
12% Negro
ECUADOR
28% Native
42% Mixed
30% European
PARAGUAY
14% Native
60% Mixed
26% European
URUGUAY
5% Mixed
95% European
PERU
1% Others
66% Native
24% Mixed
BOLIVIA
55% Native
30% Mixed
15% European
ARGENTINA
4% Native
96% European
▲
BRITISH GUI
Over 80% Europeans
50%-80% Europeans
Over 50% Native or Mixed
Over 9% Negroes
Over 80% Negroes

UROPEAN POPULATION

European colonization has moved primarily into the New World, with subsidiary movements to Asiatic Russia, South Africa, and Australia. It has flourished most, however, in the temperate zones. The spread of Negroes has been almost entirely westward, to the warmer areas of the New World, where they have entrenched themselves and set up a secondary center of population. They have expanded relatively little beyond the Caribbean area except along the Brazilian coast and the southern and eastern United States

BY HARRY L. SHAPIRO

Small percentages not shown.


AMUR RIVER REGION
6% Others
94% European
LENA AND KOLYMA RIVER REGION
89% Others
11% European
KAMCHATKA DISTRICT
79% Others
21% European
MARITIME REGION
34% Others
66% European
NORTHERN TERRITORIES
80% Natives
4% Mixed
16% European
QUEENSLAND
1% Mixed
1% Native
98% European
WESTERN AUSTRALIA
5% Natives
1% Mixed
94% European
UNION OF SOUTH AFRICA
2% Others
23% European
7% Mixed
68% Native
NEW ZEALAND
4% Native
1% Mixed
95% European
SOUTH AUSTRALIA
1% Others
99% European
VICTORIA
100% European
NEW SOUTH WALES
100% European
ers
ed
opean
ive
ro
DUTCH GUIANA
49% Others
1% European
40% Native
10% Negro
FRENCH GUIANA
4% Native
96% European

[illegible] It [illegible] the areas of immigration and in some cases resulted in the exter- [illegible] was the resettlement in the New World of approximately fifteen million Negroes from Africa. The Spaniards, almost immediately after establishing their settle- [illegible] as slaves to replace the unsatisfactory Indians. After [illegible] Dutch and the French [illegible] traffic, and by 1650 the English were also actively involved. The shipments continued as late as 1830 to Cuba and 1860 to Brazil. The total numbers thus transported can only be estimated. Between 1655 and 1787, 676,276 were known to have been legally imported into Jamaica, and in the year 1771 alone, 47,146 Negroes were carried in British vessels. From these figures it is obvious that the movement was on a large scale. DuBois has calculated the following numbers of Negroes imported into the New World.

	[illegible]	[illegible] century
	[illegible]	17th
	[illegible]	18th
	[illegible]	19th
TOTAL	15,000,000	

This total represents those who actually arrived in America. If the enormous loss of life that took place aboard slavers were added, the total number of Negroes leaving Africa would be much greater.

Historically, the Caribbean area was the center of the slave traffic, and it is here that the Negroes in the New World have most completely replaced other elements. As one moves north or south from the tropical belt the proportion of Negroes decreases. Similarly the concentration of Negroes relative to the population declines from east to west. This is very evident not only in the United States, but especially in South America. It is tempting to attribute this form of distribution in part to ecological factors of climate and environment which might have conditioned the manner of Negro dispersal in the New World, but historic factors must also have been [illegible]

In this connection it is worthy of comment that the distribution of Europeans in Central and South America also reveals a distinct pattern. The rela- [illegible] origins is least along the Andean and Cordilleran system, precisely where the native populations were heavily concentrated in highly organized civilizations. It would repay investigation to determine whether or not the well-organized masses of aborigines were able in these regions to hold their own more effectively against European encroachment than in other regions occupied by loosely associated hunting tribes. Moreover, the survival of native population in these regions offers another explanation for the relative absence of Negro settlement.

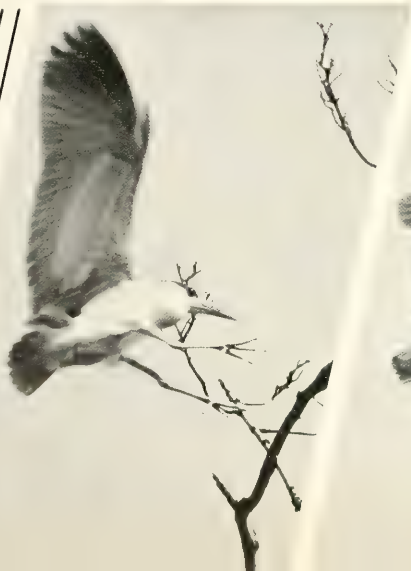
Immigrants from Asia

In the Old World, too, migrations of non-European populations have been stimulated by European expansion. Although the Chinese, Arabs, and Hindus had, long before the advent of the white man in their worlds, been known to have been expanding, the rate and extent of their migrations were enormously increased during the nineteenth and twentieth centuries as a result of conditions made possible by European hegemony. The Chinese, for example, increased their flow of emigrants to the East Indies, the Philippines, southeast Asia, Hawaii, the United States and various other parts of the world. The Hindus were moved to Africa, Fiji, and southeast Asia as labor demanded. More recently the Japanese, who previously had been closely confined to their own islands had begun a movement of emigration in various directions. These migrations of Asiatic people, although on a smaller scale and with a different history than the European expansion, nevertheless form part of the same picture of a world in population readjustment.

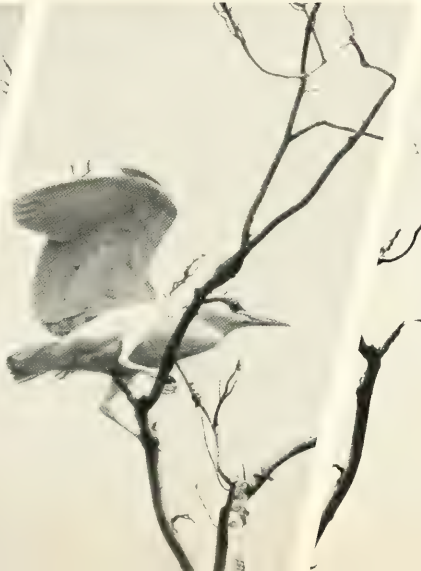
Although the movements of population in the last few centuries have been vaster and more dramatic than any we have known up to now, it would be a distortion to assume that they represent a process that had previously been negligible. On the contrary, the entire history of man, both from his written records and from his archaeological traces, reveals a constant flux of population. I doubt if one could find anywhere in the world a people whose history and records do not reveal evidence of migration. As for Europe I do not know of a single country that has not been overrun not once but repeatedly in the course of its history. What makes the present cycle of migration distinctive is the rapidity of the phenomenon, its colossal numbers, and its world-wide character.

A HERON ALIGHTS AND TAKES OFF

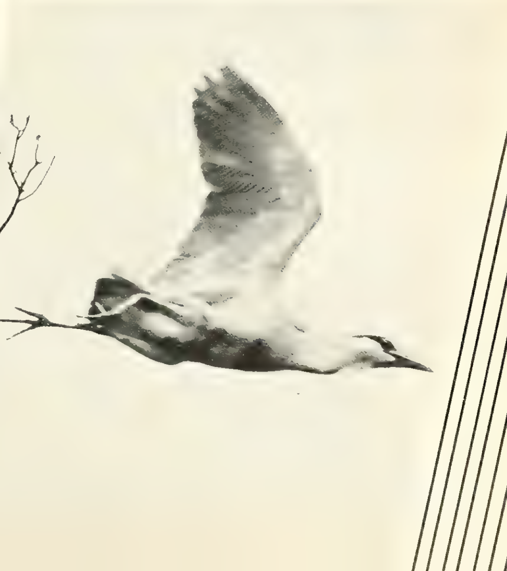
This remarkable series of photographs were taken by the accomplished bird photographer, Dr. Heathcote Kimball. They show the wing- and leg-action of the Black-Crowned Night Heron with a clarity that makes them a contribution to the study of bird flight as well as an example of the artistic achievement that is possible to the naturalist who does his hunting with a camera. The photographs were taken at Kings Point, Long Island, a few miles from metropolitan New York.



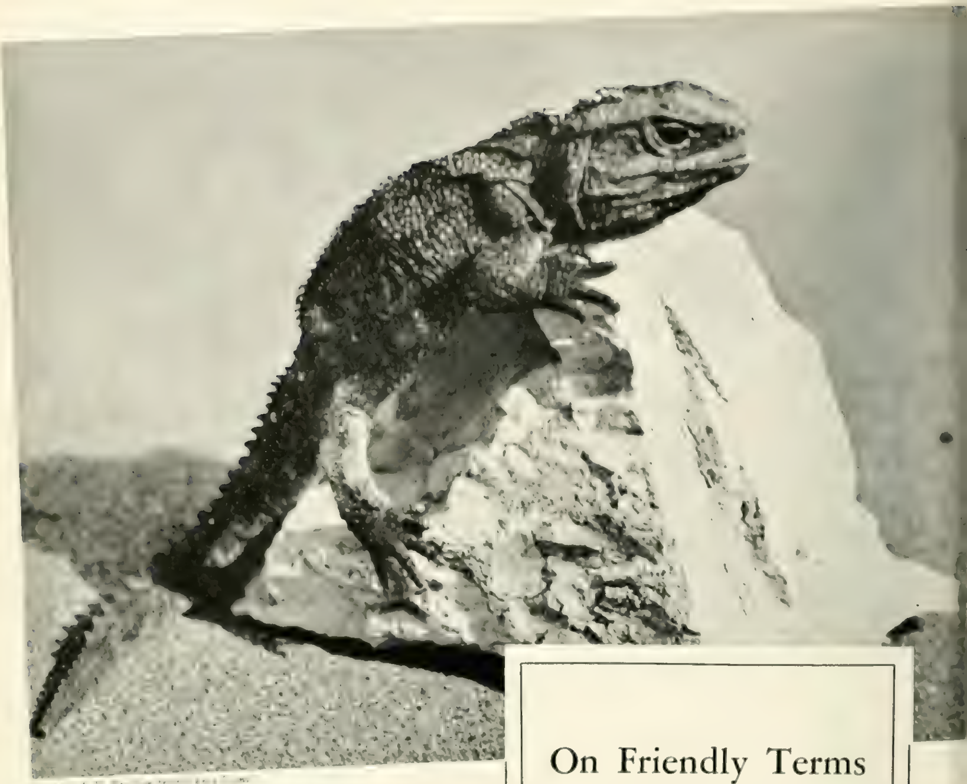
WITH TOES spread to their utmost to grasp the perch, the heron breaks its speed with its wings and comes in for a perfect landing



The feet close on the limb and the body is in perfect balance as the wings fold



A powerful thrust of the legs sends the bird forward, and the wings are prepared for a downward stroke that will carry the heron into full flight



On Friendly Terms with the TUATARA

By T. E. Donne

Over half a century ago the Government of New Zealand required me to visit Stephen Island off the coast of South Island.

In those far-off days the means of landing persons thereon were primitive, as no jetty existed and the seas were too rough to permit the use of a small boat.

My arrival coincided with a gale, and huge waves were dashing to a height of 30 or more feet against the rock-bound cliffs of this high and steep-sided island.

A rope sling was placed around my body and attached to a block and tackle outfit on the end of a derrick on the government Steam Yacht "Hinemoa." This vessel of narrow build, pitched and rolled in a lively manner; when it rolled to starboard I was hoisted high into the air and when it rolled to port I found myself in the cold embraces of white-crested waves. After seesawing several times, I was landed and unshackled in the twinkling of an eye.

On the top of this island lived the lighthouse-keepers and their families.

In the evening as the sun was setting in a blazing sky, thousans upon thousands of dove petrels came from the north. Many of them passed by Stephen Island, but many hundreds settled thereon for their night's rest after a day's scouting over the ocean in

In which a man explores the personality of the sole survivor of one of the most ancient and primitive orders of reptiles

A relic from the Age of Reptiles, the tuatara retains the vestige of a third eye on the top of its head, with tiny lens and retina

search of food. They covered the top of the island like a layer of snow.

These birds displayed no sign of fear. Some of them settled near my feet, and I saw several of them walk into holes that resembled the burrows of the wild rabbit. I promptly wanted to handle one of these dainty lookings birds and at once tried to put my desire into practice. The burrow was about two feet, six inches in length and six inches in diameter. Groping inside, I felt a bird—and something else animate, cold and "wriggly." I withdrew this and held in my hand a tuatara, last living representative of a once flourishing order of reptiles, whose ancestors date from the Triassic period—200 million years ago!

This tuatara, a female 24 inches in length, was in good condition and after a squirm or two remained passive.

The tuatara and the petrel appeared to occupy holes in common amity—a quaint association of "the Beauty and the Beast."

From a light-keeper I learned that in early days tuataras were very numerous on Stephen Island but that one of the keepers had brought a cat with him. This cat took to the bush and produced kittens, and in course of time these produced other kittens. So it went on, cats reproducing themselves until the island swarmed with cats, which lived on tuataras and dove petrels. These cats were gourmets, for they ate only the breasts of the petrels. I saw scores of remains of petrels with breasts only missing.

In the hope of checking the killing of tuataras, I there and then undertook to pay the light-keepers two shillings and six-pence for each cat that they exterminated, plus a free supply of ammunition. On returning to headquarters I officially confirmed this undertaking and sent a supply of fowling piece cartridges to the lighthouse-keepers.

The killing of cats, however, did not keep pace with their breeding propensities, the cause assigned being that they remained concealed among rocks and dense brushwood during daylight and did their "dirty work" after dark. The cats denied themselves the "luxury" of poisoned mutton.

Cats continued to increase and tuataras to decrease.

Embodiment of horror

The native of New Zealand, the Maori, nurses a superstitious dread toward all lizards, large and small, but to his mind the tuatara is the epitome of superlative horror, the embodiment of aggressive cruelty—a "thing" of evil that could enter his body and eat his vitals!

When a tribe of Maoris contemplated making war, the important men sent delegates to a friendly tribe to solicit their aid in the fighting. If the solicited party agreed to an alliance, the delegates required that their *ariki,* or paramount chiefs, eat a small lizard in a raw state, in ratification of the pledge. This was the most fearsome and binding oath of integrity that could be administered.

On my return to Wellington from Stephen Island, I took seven tuataras with me, which ranged in length from 18 to 24 inches. I have not seen a tuatara that exceeded two feet in length. And I made a recommendation to the government in respect to protecting this exceedingly interesting animal by law. At a later date an Act of Parliament was brought into operation to provide protection for the tuatara; it is still in operation.

Pets

The feeding of tuataras in captivity presented a somewhat difficult problem owing to their predilection for insects. I frequently placed some raw beef in a minced condition in their cage, but they made no attempt to eat any of it. I placed a bundle of small earthworms in front of them, but they raised their heads in disdain. When one worm disentangled itself from the coil, however, my "pet" female, the tuatara that I caught first, watched it, and when it crawled near, she snapped it up. Very slowly it disappeared into her mouth. I thought that she had eaten it, but after the lapse of a few minutes, I saw the worm gently crawling out of her mouth, apparently much cleaner than when it went in.

I provided a metal pan of water, and into this the seven tuataras promptly piled themselves and remained there night and day, except when they were disturbed by a stranger, whereupon they would hurriedly scramble into their retreat.

After retaining the seven tuataras for several months, I presented five of them to the Museum of Natural History in Wellington, keeping the large light-colored female and a dark male that was about an inch shorter.

These I removed into my office, where I provided them with a sleeping box with a hinged cover. In

[illegible]

This procedure was followed day after day, the female in front, the male a foot or more behind her. [illegible] farther the space between them. After many, many [illegible] from where I sat; she was gradually advancing, he came to anchor!

The following afternoon the female came in a [illegible] rested herself on my right shoe, and there she remained until I replaced her in the box. For some four or five days she repeated this performance, the male well in the background. Her next movement was to crawl up my leg and squat on my knee. The next day was a "red letter day," for she climbed from my shoe to my shoulder without hesitation or halt. I liked her and apparently she liked me. She turned her head "cheek by jowl" to my face, and every day thereafter [illegible] sively let me stroke her head and back.

[illegible] my room. With lightning speed the tuatara dived head first into the V opening of my vest, concealing her head and wagging her tail on my face. The visitor inquired, "What's that?" I told him, and he said. "Cripes! I wouldn't have that thing on me for a thousand pounds!" I let the tuatara remain there until after the man had left the room, as she was afraid of strangers.

The native's fear

One day a very tall and strongly-built full-blooded Maori man came to the door of my room and asked [illegible]

[illegible] He answered, "I not know; I try."

When I placed the wriggling male on the carpet, the Maori darted for the doorway, stopped, slowly re-entered the room, standing as if ready for a quick "getaway." He gazed steadily at the lizard and then [illegible] low) in the push (bush), how I horror (holler) and run away!" That was an exhibition of genuine courage, as the Maori was contending against a pronounced superstition inculcated in his mind from childhood.

[illegible] the outer door of my room. I called out, "Come in." There was no response. I opened the door and saw three figures standing about ten feet away; three corpulent Maori women came forward. I recognized [illegible] City now stands. Rangi told me that her friends would like to see the lizard. I answered, "*Hasre mai* [illegible]

They answered in chorus, "*Kaua, kaua* (no, no), we are too *p*rightened."

"*Kaua, kaua* (no, no), we are too *p*rightened." They bent forward in crouched positions. I elected to show them the male tuatara, because of his violent squirming act when handled. At one glance, a trinity of screams broke out, and the three women scurried away in the darkness. Their courage was not equal to their curiosity.

The following morning Rangi who, by the way, wore as earrings two of her late husband's molar teeth, mounted in gold, returned. Standing nervously several feet away from the doorway, she asked, "*Toone*, you see the sausage?"

"Which sausage?" I inquired.

Rangi answered, "Last night the *nga wahine* (women) get the *p*light for the tuatara; run away; lose three-pound sausage for the supper."

Regretfully I told Rangi that I had not seen the sausage. A fright that would separate three fat women from three pounds of sausage must have been real.

Young

In the summertime I transferred the pair of tuataras to my home and provided a hutch for them in the garden. The female produced sixteen eggs. These I placed in a wooden box that was partly filled with fine sand, which I covered with a wet corn sack exposed to the sunshine.

In a few days short of three weeks, hatching began, and I saw that at least seven lizards had emerged from their cells. Hatching continued, and I allowed three more days for its completion. Early in the morning of the fourth day I went to examine the "incubator" and found it had been overturned and that every young lizard had disappeared.

A collie I possessed had had pups, and during the night she had eaten the brood of tuatara. *Aue! Aue!* Alas! Alas!

The mounted remains of the first pair of tuataras that I caught on Stephen Island in the eighties now repose in a glass case in my home in London.

NICKEL Continued from page 77

to balance all the sulphur and into which almost 6% of nickel is sometimes intruded. A fresh surface has a bronze metallic luster, but it readily alters and tarnishes, so that most collection specimens fail to give a true idea of its appearance. Among the Sudbury deposits are other nickel minerals—pentlandite with 22% nickel, and polydymite with 53%—but they are not conspicuous.

In one method used in New Caledonia, the ore is mixed with calcium sulphate and smelted in a blast furnace to form a "matte," which is a complex mixture of iron and nickel sulphides. This product is very similar to that obtained by smelting the Canadian sulphide ores, except that there the matte contains copper as well as nickel, which adds to the complications. One interesting alloy, however, namely Monel metal, is smelted directly from the copper-nickel matte, the ratio of copper and nickel being adjusted during the treatment to produce the white, corrosion resistant alloy that has become popular in kitchen sinks. It contains about 70% nickel and 30% copper.

Pure nickel accounts for very little of the consumption. Some has been used in plating, and more in coins. The Axis nations have found the latter a readily available reserve during the present conflict. Italy managed in 1940 to get 1600 tons from the one- and two-lira coins and expected to get 2900 more from the smaller values. In 1941 the Czechoslovakian Government withdrew nickel coins from circulation. Some nations, however, use copper-nickel alloy coins. Our most familiar example is the five-cent piece, which contains only 25% nickel.

The world used 256,000,000 pounds of nickel in 1939 and proportionately more (the exact amount is a carefully guarded secret) in 1940, 1941, and 1942. Most nickel goes into steel alloys. Before the United States started to rearm, about 64% went into iron and steel combinations; today the percentage must be far higher because of priority allocations.

It is surprising what differences very small percentages of certain metals can make in the properties of steel. We saw that tungsten imparted great hardness, while manganese improved the workability. Low percentages of nickel increase the strength, ductility, hardness, and toughness. Higher percentages also affect the heat and corrosion resistance. Stainless steel, the alloy which gleams from the Empire State and Chrysler Buildings, is commonly known as "18 and 8," for it contains 18% chromium and 8% nickel. The toughness that is imparted to steel by nickel is also important at abnormally low temperatures, when steel becomes notoriously brittle. It is interesting to speculate that some of Herr Goebbels' troubles with the Russian winter may have been due to the Axis nickel shortage.

Chemically, nickel is closely allied to iron, and like it, is magnetic. Different combinations of these two metals result in exceedingly variable magnetic properties. The "Alnico" magnets, which will support 16 times their own weight, contain 20% nickel, 12% aluminum, and 5% cobalt. In electrical equipment where strength plus a lack of magnetism is desirable, combinations of iron and 20 to 30 per cent nickel are used, for these can be made nonmagnetic by heat treatment. Another alloy, with 36% nickel in iron, is practically without any expansion and contraction at atmospheric temperatures and is therefore useful for steel measuring tapes, watch parts, etc. Thermostatic elements are composed in part of this alloy. Another interesting alloy of iron, nickel, and cobalt has the same contraction and expansion properties as glass. This is used in making glass-to-metal seals in radio tubes and similar products.

Corrosion resistant surfaces for equipment handling chemical and food products are achieved by plating ordinary steels with pure nickel, nickel-steel, or nickel-copper alloys. The union between nickel and steel in these combinations appears to be very strong. In a test the steel broke under stress before separating at the nickel-steel juncture. Nichrome wire used in electrical heating equipment contains 80% nickel. And in the chemical industry other less expensive alloys with some iron are made for specialized uses. The classic "18 and 8" resists nitric acid, while Monel metal resists sulphuric acid.

German silver, now known as nickel silver, is the base for much silver plated flat and hollow ware. Since bowls and platters made of this also contain copper, lead, zinc, and tin, we cannot expect much civilian manufacture during the war. Bronzes in which a little nickel replaces some of the tin have been found to have a greater resistance to corrosion. White gold contains nickel and a little zinc, with a 20% impurity necessary to give the color, so that even the purest white gold is not much over 18 carat in grade. Nickel is also an important ingredient in the Edison storage battery, which uses nickel oxide and iron in place of lead.

Truly the uses to which nickel has been put are many and varied. Much of the development has been due to research by the producers, who have endeavored to stimulate the use of nickel in peace. Today most of these new uses must give way to war demands, but afterward we can expect many new applications and extensions of the present ones.

Though Canada today supplies most of the world with nickel, this may not always be the case. Under present requirements, even the large existing production is insufficient, and additional deposits are being investigated. Prospects look good for nickel recovery from some Cuban nickeliferous iron ores and for the development of an extensive Brazilian deposit. Recent estimates indicate that nickel could be obtained from the Brazilian deposit more cheaply than the present price of 35¢ a pound, but 220 miles of road must first be built, a dam and plant erected, and all equipment supplied—not a feasible task in this crisis.

It is a long way from a known deposit to a productive mine, despite recent newspaper publicity regarding so-called newly discovered ores in our West. A few years ago, before Russia became a "democracy," American geologists, mining engineers, and economists derived considerable amusement from their method of discovering new ore deposits. All that was required, apparently, in order to transform a questionable deposit into vast ore supplies was a drill record and a couple of sharpened pencils. Most "new" American discoveries publicized today, alas, fall into the same category, though the Bureau of Mines should not be blamed for the deception.

Don't worry, however, about our nickel supplies. The Axis has practically none, and we shall have enough with what we are getting and can get from Canada. More could be obtained by proper reclamation of our scrap iron. It is estimated that 1,000,000 pounds of nickel could be reclaimed each month for use in steels. And don't take the publicized Arizona "deposit" seriously until you hear that it has actually produced some nickel, at cost or profit.

Photographing Radioactivity

By [illegible]

B[illegible] the plate in the plate-holder after all. [illegible]

The mineral gave no indication of giving [illegible] off an invisible radiation that could pene[illegible] This discovery opened the entirely new [illegible] fundamental facts of matter.

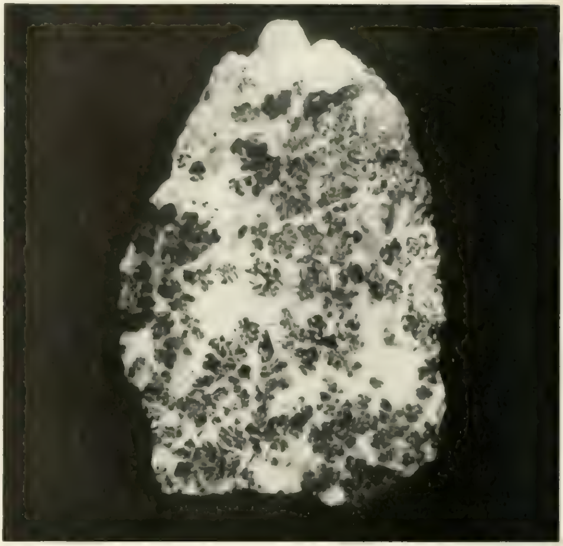
The radioactive minerals are usually [illegible] is gradually and spontaneously breaking down into simpler elements. This disrup[illegible] of helium, electrons, and an extremely penetrating radiation. The charged atoms, called Alpha particles, are responsible for [illegible] rials, causing them to glow.

[illegible]

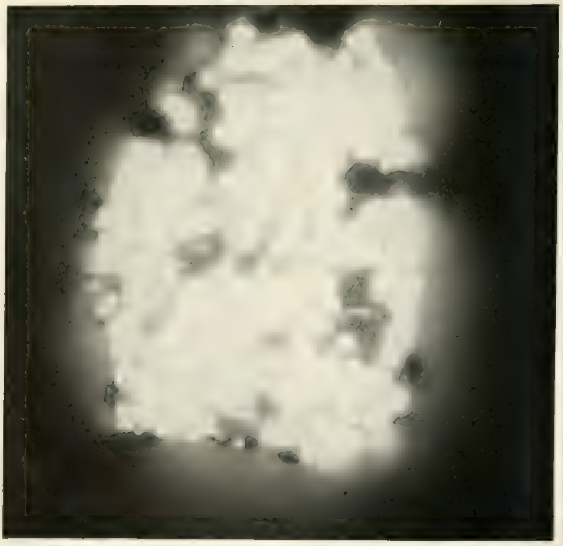
Uranium ores such as pitchblende, carnotite, and uraninite are all radioactive to greater or less degree, depending upon the concentration of the radioactive metals in them. [illegible] active metal, the quicker will these minerals produce their effect on a photographic film or plate.

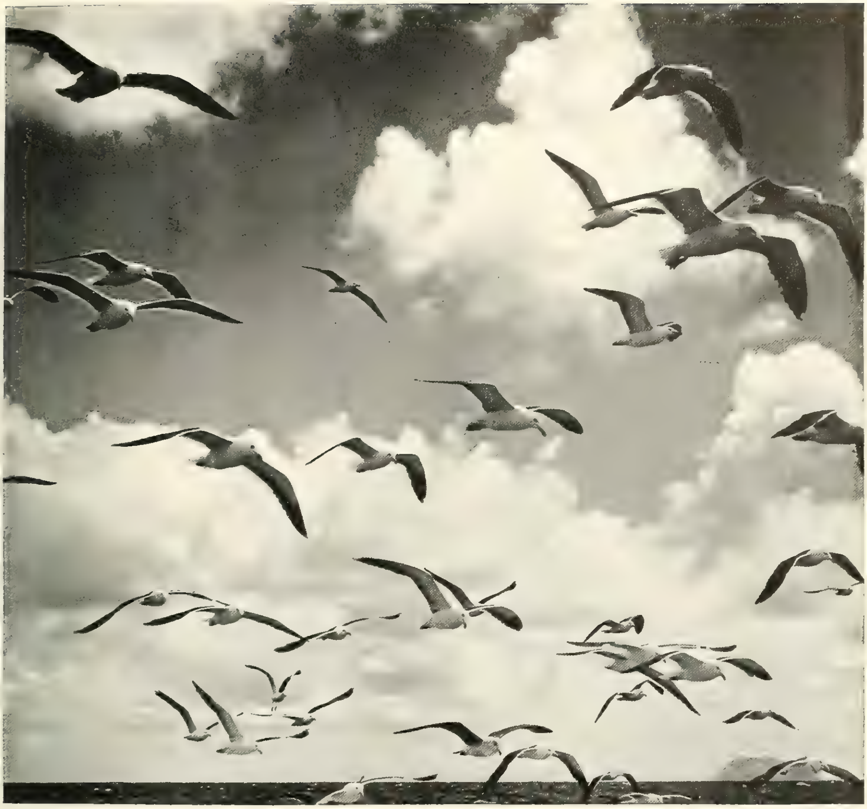
To photograph these minerals under ordinary light involves no unusual methods, but to let them take their own picture is a novel experiment for most photog[illegible] remove the photographic plate from its package and place it emulsion side up in the bottom of a box. Then put the radioactive mineral upon the plate, close the box, and snap a rubber band around it. It is important to keep the box closed tightly and prevent light from leaking in. Then set the box aside in a convenient place, preferably in a dark closet, for about a week.

The film or plate, whichever is handier, can be of almost any kind. Medium lantern slide plates may be used for this type of work. The speed of the plate has practically no effect upon the length of exposure, so there is no need of using high speed emulsions. The concentration of the radioactive element in the ore does more to determine the minimum exposure time than the emulsion speed. Since this concen-



Above: Uraninite photographed under normal light, showing the dark areas that are the radioactive uranium ore. *Below:* The same specimen photographed in complete darkness by placing it in contact with a photographic plate. Note that the dark areas are now the bright ones





Frozen flight

To stop action in a picture like this, it's necessary of course to use a high shutter speed. And it is also desirable to keep the camera 'stopped down' for good depth of field.

This picture was taken at 1/350th of a second at *f*8, *with a yellow filter*. The film that made the picture possible was Agfa Ansco Superpan Press.

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[illegible]

[illegible] graphic plate

[illegible] prepared. The bottom of a shallow box [illegible] with uranium ore or, better still, with crys- [illegible] yellowish crystalline material obtainable at [illegible] prints in various colors.)

Place several metal keys, metal washers, [illegible] the photographic plate which you wish to expose with the Beta rays. Then set your [illegible] week. When the plate is developed, the [illegible] tervened will have been fogged by the radiation from the uranium salt.

Certain unscrupulous spiritualists have used radioactive materials in producing so-called "spirit photographs." Unknown to [illegible] painted in an invisible and strongly radioactive solution upon the dark side of a pho- [illegible] Beta rays from this material produce a foggy image on the plate. Then when the victim is photographed in the usual manner on the same plate, a ghostly face, claimed to be that of the deceased friend or relative with whom he desires communication, appears in a mysterious way on the plate beside his own.

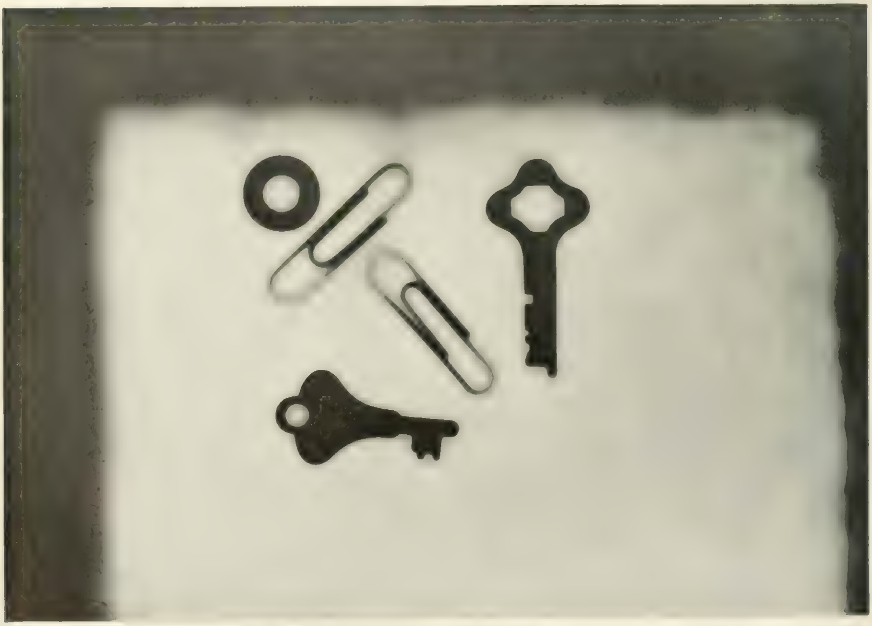
[illegible]

To the amateur, filming radioactivity is just another stunt, but industry has found [illegible] Radium salts are a very powerful emanator of these Alpha, Beta, and Gamma rays. The Gamma rays are extremely penetrating and likewise extremely dangerous to living tissue. With proper care, this radium salt can be used to detect flaws in heavy metal castings. The radium salt in a lead container is placed against a casting so that a tiny hole in the lead container faces in the direction in which the rays are to penetrate. The lead sheathing prevents the rays from escaping freely in all directions and endangering those who handle it.

On the opposite side of the casting a photographic plate is placed and left to expose for a matter of hours or days, depending upon the thickness of metal to be penetrated. After the completion of the time found by experience to give the best results, the plate is developed and examined. Blowholes in the depths of the metal show up clearly in the pictures as darker areas on the negative where more Gamma rays were permitted to pass.

The use of a complicated X-ray machine [illegible] In some places, [illegible] impossible to place an X-ray tube, so radium comes to the rescue. Thus the accidental discovery of Antoine Henri Becquerel has proved of service to modern industry.

"Spirit photograph" of keys. This picture was obtained by placing a box containing uranium nitrate on the metal objects on a photographic plate that was shielded from all visible light. The plate is sensitive to rays which we cannot see and which penetrate opaque substances



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U R G E N T

The Museum Library is in need of back issues of NATURAL HISTORY, particularly the first four issues for 1942. Copies sent to the Librarian, The American Museum of Natural History, New York, will be greatly appreciated.

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SUCCULENT PLANTS

by [illegible] J. Alexander

[illegible]

A [illegible] author. Here will be found cacti, century-[illegible] ican deserts; euphorbias, stone-plants, windowed-plants, aloes, and others of the Old World. The surprising beauty and variety of these plants, so well shown in [illegible] for the lure of the desert.

[illegible]

BIRDS AROUND NEW YORK CITY

by Allan D. [illegible]

American Museum of Natural History, $1.75

THIS [illegible] from a vast amount of data supplied by some hundreds of observers, among whom the author himself is one of the foremost. It contains an accurate summary of the available information on the bird life around New York City. The pred-[illegible] by [illegible] published in the same Handbook Series, is now out of print and has, for some time, been out of date owing to the rapid changes that have taken place in the local status of many birds. An important feature of Mr. Cruickshank's book is the account it gives of these very changes.

The area embraced has been somewhat extended in this present volume as is shown in the maps that form the endpapers. The text opens with an analysis of the avifauna of the area, first by ecological block, of which fifteen of the most important are briefly described, each with its birds of the different seasons. Numerous lists for the entire region then show different classes of residents, visitants, and transients, and in a detailed account of the changing seasons by months and fractions of months, the migrants are listed in their proper periods. Finally, the bulk of the volume is devoted to a discussion of each species, comparing its present with its former status and giving something of its local distribution and habitat, its nesting, and its time of arrival and departure, with emphasis on the normal condition rather than the exceptional.

The illustrations are fine examples of excellent photographs for which Mr. Cruickshank is already noted. They follow the most modern style of printed illustration, occupying the pages to their full extent and requiring the captions to be placed on the opposite pages, not an unmixed advantage.

The volume should have a long and useful career and without question should be in the hands of everyone who is at all interested in the birds of New York City and the surrounding country.

[illegible] T. Zimmer

ORNITHOLOGISTS OF THE UNITED STATES ARMY MEDICAL CORPS, Vol. I

by Edgar Erskine Hume

Johns Hopkins Press, $5.00

IT requires only a glance at Colonel Hume's five pages of "Acknowledgments" to realize the number and variety of the sources on which he has drawn for the great store of information contained in this stately volume.

To ornithologists the names of Coues and Mearns will at once occur as eligible for inclusion here, but Colonel Hume has found 34 others whose service to the Medical Corps and the science of birds has won them a place in his hall of fame. One asks what part the innate interests of the born bird lover played in their selection of a calling? The result is an addition to birdlore and history most of which would have been unrecorded had it not been for the author's researches.

As we read the records of expedition after expedition into our then little known West, we are impressed by the fact that the men who served on them were pioneers in the best sense of the word. To unlimited hardships were added the dangers of entering a hostile country, and the excitement of collecting new specimens was accompanied by the possibility of encounter with savage foe. One recalls Bendire's account of his difficulty in disgorging a pair of hawk eggs he had hastily placed in his mouth when, on reaching a treetop nest, the discovery of watching Indians prompted a speedy descent and retreat.

Army men and civilians alike will welcome Alexander Wetmore's introductory tribute to Professor Baird, who was chiefly responsible for the appointment of men to the Medical Corps who, in addition to their professional duties, might [illegible] the Smithsonian Institution.

[illegible] M. Chapman

THE HOUSE IN THE RAIN FOREST

by Charis Crockett

Houghton, Mifflin Co., $3.00

MRS. CROCKETT gives us an interesting and vivid description of the life she and her husband, a physical anthropologist, led in Dutch Guinea.

Sponsored by the Academy of Natural Sciences of Philadelphia, and accompanied by an ornithologist, another friend, a captain, a sailor, and a cook, they sailed from Gloucester, Massachusetts, to New Guinea on their 59 foot schooner, the *Chiva*. The company also included a parrot and a kinkajou. Mrs. Crockett was a lover of animals in no small way. The kinkajou was followed by a wallaby, who was always trying to crawl into bed with one of the company. A small tree-kangaroo was her main pet.

Mrs. Crockett is at her best translating to the printed page her sensitive, vivid impressions, whether they be of birds, of cockroaches, of the forest, or of the Papuan natives. The Madiks, among whom the Crocketts stayed for seven months in order to take measurements, were a gay people, and the author gives us understanding character studies of a number of them. The writer neither romanticizes native life nor her own life among the natives. She tells us about the pain and discomfort of malaria, the nuisance of rats, the constant company of cockroaches, the mud, and the weariness from long treks. But none of these really affected Mrs. Crockett's enjoyment of life.

Mrs. Crockett's training is obviously that of a physical anthropologist, but in an unpretentious way, she gives us a little ethnological data about the Madik people, interwoven with her personal story. We learn something, in a rather unorganized manner, about their origin myths, their clan organization, their economic system, their initiation rites, and about their beliefs concerning life after death. From the point of view of a social anthropologist, the reviewer finds her a bit naive because she describes customs which are quite common to many natives in Oceania as unusual or curious.

This book is one of the best personal accounts of the white man's life among a primitive people.

HORTENSE POWDERMAKER

THE INTERNATIONAL PROTECTION OF WILD LIFE

- - - - by Sherman Strong Hayden

Columbia University Press, $3.00

DR. HAYDEN'S study of the many-sided subject of conservation relates to agreements between nations for the preservation of wild birds and mammals. It is divided into chapters that deal, respectively, with the protection of natural communities (such as African "big game" and New World birds), the responsibility for migratory birds that cross international boundaries, and the struggle toward wise use of valuable marine mammals, including both seals and whales.

This is a powerful and eminently civilized book. It is primarily a historical document, and yet in many noble passages it gives short shrift to the mean and narrow *pros* and *cons* as to why this or that element of the world's fauna is worthy of indefatigable human effort. While accepting the utilitarian point of view, the author far transcends it; he places the whole problem on an ethical plane that can hardly fail to appeal to men of good will.

Because of the incredible variety (and, incidentally, the stuffy lack of generosity) in human points of view, the obstacles to effective international conservation have, in the main, proved appalling. That Nero has been fiddling while Rome burns there can be not the slightest doubt. If the next few decades are to have any chance of improving upon the past, the forthcoming peace treaties must permit the animal life of the world to share a much larger proportion of the consideration usually reserved for mankind.

In a text that has been carefully considered and scrupulously edited, a few errors have, nevertheless, crept in. Fortunately, these have little bearing upon the author's thesis. For example, in comparing knowledge of European routes of bird migration unfavorably with that recorded for North America, Doctor Hayden has obviously been misled by published charts which are to a certain extent specious. The pretty representations of "flyways" to which he refers have only a general application, except as regards a few species of wild fowl. Most birds migrate on a "broad front," and the European routes are actually known in greater detail than our own, because of the far larger number of banding records in the Old World.

R. C. MURPHY.

VOLES, MICE AND LEMMINGS

- - - - - - - - by Charles Elton

Oxford University Press, $10.00

THE author defines the title as "Problems in Population Dynamics," and this book, of nearly 500 pages, is an exhaustive and scholarly account of the fluctuations in the numbers of these small rodents, as well as some other animals.

Plagues of mice received attention in the Old Testament, when "Mice were generated and 'boiled over' the towns and fields in the midst of that region and there was a confusion of great death in the land. Elton devotes an interesting first chapter to vole and mouse plagues in ancient history. Eventually he documents all records for these phenomena.

Periodic concentrations of mice levy heavy tribute upon vegetation. They become an economic menace and much study has been given to methods of control. Despite a periodic increase in the numbers of mammals and birds preying upon the mice, these natural enemies cannot hold the mice in check. The classical example of this building up of numbers until the country is too small to contain them is the lemming of Scandinavia. The mass movement is of such proportions that, although great numbers are killed by accidents and gathering enemies, "in 1868 so many swam out into the inner parts of Trondhjem Fjord that a steamer took a quarter of an hour to pass through them."

One of the author's principal purposes in studying these fluctuations in rodent populations is to discover causes and underlying patterns of this periodicity. The story is not a simple one to be fully explained by favorable food cycles. "So we are left, ..., with a good many hints of some great cosmic oscillation, expressing itself in periodic upheavals in the biotic community, but we still lack the full key to the problem."

This book will stand for many years to come as an authoritative text and standard reference on the subject it so ably covers. This reviewer believes the author would have made his book more useful if he had summarized. The reader is left without a résumé of just what Elton believes himself.

H. E. ANTHONY.

THE AGELESS INDIES

- - - - - - - - by Raymond Kennedy

John Day Press, $2.00

THIS book comes at a time when we know it is needed. The pity is that there were not a dozen books of this sort on sale in America ten years ago. Now, at any rate, we know that we need information about the Netherlands East Indies and about colonial administration.

Doctor Kennedy's story of this region is an interesting one. The Dutch had wisdom and took the trouble to study their native peoples—, yet the islands fell to an invader as easily as Holland itself.

The Dutch were among the first to attempt "indirect rule." They were not hungry for the pomp of power and took no joy in coercion, but they wanted peaceful control. They therefore preserved the native systems of administration and installed their own officials as "advisors" to the native princes. They touched the native system only at the top and did not, like the British, patrol the native villages, instructing and interfering at the "grass-roots" level. Doctor Kennedy says that the Dutch policy was dictated by economics, and that is certainly part of the story. He respects the Dutch. I, who candidly like them, suspect that another reason for "indirect rule" was that the heavy and unworried Dutch just disliked walking.

Under "indirect rule" compulsory labor on the roads, which existed in Indonesia long before the Dutch came, persisted. And European education, though offered, was not pressed on the natives. Doctor Kennedy says that in the nineteenth century the Dutch positively delayed education, but they no longer did this in 1936-39 when I was there. Certainly pro-Dutch feeling was not industriously promoted, and the natives remained politically naive. They were content to be well governed. And the islands fell. If uninterrupted, the patient system of the Dutch might have enabled the natives to take their place among the nations of the world, in perhaps another hundred years. The Dutch knew how to let things grow without forcing them, but we have to solve a more difficult problem—how to stimulate and educate without coercion.

GREGORY BATESON.

NO LIMITS BUT THE SKY

- - - - - - - - by Mary B. Kidder

Harvard University Press, $3.00

THE Preface of this book was written by the author's father, the well-known Director of the Museum of Comparative Zoology at Harvard, who takes justifiable pride in the simple diary of his daughter. The book might have been titled, A Peruvian Diary, for it is just that, and is based upon two archaeological expeditions with her husband to the land of the ancient Inca empire, one in 1937 and the other in 1939. It happens that the author's husband is an archaeologist of the second generation, his father being the well-known student of the ancient peoples of our Southwest.

These young people, however, are not living on the reputations of their famous fathers, but are abundantly able to stand on their own feet, as is made clear by this account. The diary was evidently not written with the idea of publication, and it has not been dressed up for that purpose. It contains no technical scientific archaeology, but it is a human day-to-day story of their experiences in this most fascinating country. Mrs. Kidder tells how they traveled, where they went, what they saw, how they lived, and how the native Indians lived, giving just the information that every fellow-traveler would like to have.

It is the more interesting to this reviewer because, while leader of the American Museum Eclipse Expedition to Peru in 1937, his trail crossed theirs. Among the places described are: Trujillo; Chan-Chan, the largest ruin in Peru, covering eleven square miles; Hacienda Chiclin and the famous Larco Museum; Lima, with its National Museum, and the University of San Marcos, the oldest university on the American Continent; Pachacamac, with Dr. Julio C. Tello, Peruvian archaeologist; Arequipa and the Quinta Bates; Cuzco, the Capital of the ancient Inca Empire; Macchu Picchu; Lake Titicaca; and Tiahuanaco.

The book will be welcomed by all those

[illegible]

[illegible]

ANIMALS ARE MY HOBBY

by Gertrude Davies Lintz

[illegible]

FEW [illegible]

[illegible] chimpanzees and gorillas. Between these [illegible]

[illegible] quite absorbing, with their tales of champion after champion, some attaining the [illegible]

However, the chimpanzee and gorilla [illegible] tific kennel, feeding, and training routine. [illegible] techniques in learning through play. Those almost human creatures, Gargantua of [illegible] and Massa [illegible] the Philadelphia Zoo [illegible] linquished from her care only when their great size and marvelous strength made them too great a responsibility for a household.

Mrs. Lintz tells many tales of appealing little chimpanzees with lovable baby traits, who grew up under her care to [illegible] years [illegible]

[illegible]

THE CONSERVATION OF NATIONAL RESOURCES

by George T. Renner

John Wiley & Sons, Inc., $2.75

WITH the tremendous but necessary waste of resources caused by the war, we can only hope that the public, [illegible] the individual responsibility for the saving [illegible] by this experience when the war emergency has passed. American teachers of every kind and degree must realize the [illegible]

Of all that has been written on resource conservation [illegible] books, and teachers' manuals to popular editions—this is the first standard-sized [illegible] tional purposes, problems, and methods involved in teaching resource conservation.

[illegible] tion movement, and the necessity for an educational attack on conservation problems. Part Two is an outline of the natural and human resources of our country, [illegible] remedies. In Part Three the materials for conservation education are listed and [illegible] indicated, and problems of curriculum [illegible] form. Here we find that conservation cannot be treated as a "subject," but [illegible] living. It can be as logically taught in relation to nature study, science, and agriculture as in the social sciences.

Renner's book places a valuable tool in the hands of our teachers. Their own wisdom and foresight will determine the extent to which it fulfills its purpose.

[illegible]

THE FACE OF SOUTH AMERICA

by John Lyon Rich

American Geographical Society, $4.00

AERIAL photography, and elaborate map-making based upon it, have become commonplace. Bulky and expensive professional equipment is ordinarily used in exposing the negatives and in the subsequent cartographic translation of the data. It has remained for Professor Rich to show that the "aerial traverse," involving precise geographic location of every view, can be successfully carried out with a miniature camera operated through the windows of commercial planes. After experiments along air lines in the United States, the author recently extended his field to the grand tour of South America, and this beautiful and revealing volume is the result. He calls it a "book of pictures," but it is only fair to state that the route maps, the explanation of method, the brilliant interpretive comments on each of the 300 photographs, and the incidental light cast upon historical, agricultural, industrial, and other human interests provide at least half the treasure.

In sequence, the photographs sample [illegible] and across a continent and yet the land types are almost all inclusive. Equatorial rain forest, river systems, elevated and [illegible] broad and shallow [illegible] coastal platforms, [illegible] savanna and desert, [illegible] and mighty [illegible] all pass in rapid review. Man-made modifications [illegible] of the remote prehistoric past as well as contemporary land use, while at the same time many future possibilities and desirable or essential [illegible] are clearly indicated. Particularly [illegible] are the opportunities noted in [illegible] and the related text which [illegible] the greatest water power [illegible] in the world because of the presence of permanent rivers on the [illegible] plateau which are yet close enough to the escarpment to have part of their water readily short-circuited into a drop exceeding 2000 feet.

R. C. Murphy

BYWAYS TO ADVENTURE

by Edwin Way Teale

Dodd, Mead & Company, $2.75

MR. TEALE is becoming justly famous for his aid to nature hobbyists who, like himself, spend the major part of their free hours becoming more familiar with the world out-of-doors. This current guide is excellently organized and is by no means merely a collection of miscellaneous information. Step by logical step, the author wanders with discipline through activities which include bird watching, weather observations, astronomy, insects, reptiles, mammals, and the world of plants. He does not neglect geology or the "Wonderland of the Microscope." His outlook on wild life conservation is sane and could well be followed by many who tend to go overboard on this subject. Excellent bibliographies serve as an up-to-date library list for any nature student. A particularly stimulating chapter concerns "The Outdoors Brought Indoors—Museums." Mr. Teale presents a list of outstanding museums both large and small, state by state, and provides sound advice for collectors who wish to spend long winter evenings studying and preparing for exhibit, objects found in the open.

The following point of view struck us as being particularly worth-while at this time: "It is a significant fact that in 1940 more people visited the natural history museum in London than had entered its doors on any previous year. During the same twelve months of shock and uncertainty, the membership of the American Museum of Natural History, in New York City, rose to the highest point in the records of the institution."

A valuable asset for either calm or troubled hours is an interest in the natural world about us. Hobby trails in the field of natural history are byways to quiet but real adventures. From boys with energy to spare, to retired professional men with time on their hands, numerous people have found opportunities for fun and relaxation—and sometimes achievement as well—in nature avocations.

W. H. Carr

OPEN FOR YOU
$1600 in Prizes
Offered by
Natural History Magazine
See Page 58

AN ENGLISH 13TH CENTURY BESTIARY

- - - - - - by Samuel A. Ives and Hellmut Lehmann-Haupt

H. P. Kraus, New York, $1.85

ONE of the most popular books of all time is now almost forgotten and its original text is lost. It was written by someone whose pseudonym was Physiologus and who perhaps lived in Egypt in the second century. The medieval bestiaries were made up largely of quotations from Physiologus, accompanied by quaint and highly imaginative paintings of animals. The text drew parallels between the supposed habits of these animals and the morals of ancient and medieval Christianity.

The volume here under review is a technical discussion of a manuscript bestiary, the peculiar interest of which is the light that it throws on mass production of books before the invention of printing. Lehmann-Haupt believe that this was a model book used by medieval scribes as a guide for copying. In many of the illustrations the outlines of animals have been pricked as if to make a perforated pattern. This pattern may then have been used like a stencil to transfer the picture to another volume, after which the painting could be quickly filled in by hand. The discovery has unusual interest for bibliophiles and gives additional evidence of the great popularity of the medieval version of natural history.

G. G. SIMPSON.

DESERT WILD FLOWERS

Revised edition

- - - - - - - by Edmund C. Jaeger

Stanford University Press, $3.50

THE lure of the desert is universally recognized, and every traveler is no doubt surprised on his first visit to these arid regions by the abundance of flowers and trees, especially at certain seasons of the year. Everyone is intrigued by the adaptations of plant life to this land of little rain. And everyone wishes to know the names of the conspicuous plants at least. The naturalist, moreover, wishes to be able to find out the name of any and every plant that he meets.

Here is the book to give that information. It is based upon 25 years of tramping and sketching by an enthusiastic lover of the wild flowers of the desert, who is also professor of biology in Riverside Junior College. Seven hundred and sixty-four desert plants are described and illustrated. There are many photographs, but by far the most of the illustrations are line drawings, nearly all made from living plants. As pointed out, the line drawings show better than any photographs (even colored ones) the details of structure which make identification possible. To draw so many plants in their native habitat, the author tells us, involved traveling over 30,000 miles of desert roads and trails.

The book emphasizes the fact that the deserts are not as barren as commonly believed, for there is not a month in the year when the far Southwestern American deserts are completely without flowers. Not only is information about the plants given, but scattered all through the book are many interesting bits of general natural history, such as the relation of birds and insects to various plants, the uses of parts of various plants by the Indians, the work of pioneer botanists, and the like.

A key designed for the quick identification of unknown plants found in these deserts is included, having been prepared by Ruth Cooper, botanist of Riverside Junior College, Riverside, California.

CLYDE FISHER.

AN INTRODUCTION TO THE PLANT SCIENCES

- - - - - - by William C. Darrah

John Wiley & Sons, $2.75

THE publishers of this book have recently printed a series of six text-books (survey courses) of the sciences, namely, physics, chemistry, the body functions, astronomy, biology, and earth sciences. Botany was not given separate treatment in this group of books, but here is a volume by a Harvard University professor that logically fills this gap. It was written for students who will take a half-year course in botany, and who presumably plan no additional work in the field.

It was not designed as an aid in learning to identify or classify plants, but is a text-book of plant biology. Plants are treated from the standpoint of plant functions or plant physiology—from the standpoint of biophysics and biochemistry. The book is carefully written and well illustrated, and we are given the modern conceptions of evolution, variation, mutation, and heredity in plants.

Growth and reproduction are treated, as well as transpiration as the cause of the ascent of sap, the distinction between respiration and photosynthesis (often not clearly presented in text-books), soil-erosion and its control, and the origin of plants as indicated by the fossil remains. Altogether it is an excellent text.

CLYDE FISHER.

PASSPORT TO ADVENTURE

- - - - - - - by Lewis N. Cotlow

The Bobbs-Merrill Company, $3.50

SHOULD a young man who longs for travel and adventure grasp the first opportunity; or should he apply himself to business, and travel after his fortune is won? Lewis Cotlow shows admirably that both ways may be right. After the armistice of 1918 he was a cocky young supercargo on American ships bound here and there around the world. When supercargoes were dropped, this one returned to New York and entered the insurance business.

No extensive travel was possible for six years, and then Cotlow stuck to tourist routes until 1937, when he realized a burning ambition to see Central Africa. An Imperial Airways plane carried him

Natural History
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COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration—Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

[illegible]

[illegible]

[illegible] when an old airplane engine failed mo- [illegible]

Just now the war seems to have voided [illegible]

[illegible]

THE COVER THIS MONTH

[illegible] natural size, being scarcely more than ten inches in length, exclusive of the thirteen-inch tail. The tail is non-prehensile, and the monkey often winds it around its body when at rest. However, the squirrel monkey is an extremely active animal and spends much time scampering about the tree tops far above the ground. These monkeys are native to South and Central America and are often kept by the natives as pets, being very playful and good-humored. They feed on fruit and insects.

Dogs for Defense

T[illegible] eight men, thus releasing that many [illegible] on a dark night when a human never could. Sentry dogs are needed in the [illegible] airplanes, warehouses, munition dumps, [illegible]

The Germans are using 50,000 sentry [illegible] Russia also has 50,000 attached to their Army. We have only 67 in training. [illegible]

So line up all the suitable dogs that you can so they may be immediately put in training. Let's not have "too little and too late" in this effort. Any purebred medium size dog will do. The training period is usually two months, with a minimum of one and one-half hours a day. A large number of trainers have already volunteered and are training Army sentry dogs. You can help by giving a dog or your services as a trainer. Write to: Dogs for Defense, 22 East 60th Street, New York, N. Y.

Dogs given for this service become the property of the U. S. Army and will not be returned. When the war is over they will be kept, bred, and trained for these duties.

Any purebred dog of either sex, physically sound, between the ages of one and five years, with the characteristics of a watch dog is likely to pass as suitable. Pedigree papers are not necessary. The dog must be larger than a fox terrier and [illegible] St. Bernard!

Obedience

Heel: On command, the dog must stay at heel on the left side of his handler, whether on or off lead. Absolute steadiness is necessary rather than perfection of [illegible]

Stay: The dog must stay, on command [illegible] either in a sitting or down position. He must demonstrate instantaneous response to the command and should show no inclination to become restive.

Out [illegible] the dog must go out and search in the direction indicated by the handler.

Come The dog must return to his handler [illegible] command, regardless of various distractions.

The dog must give warning at all times of the presence of strangers by coming to attention, barking, or growling. He need not be vicious or want to bite strangers. In fact, such dogs might actually be dangerous in this work as they might go for the corporal of the guard, officers of the day, etc. The sentry dog is merely supposed to locate strangers and give warning. If any blood is to be spilled, that is what the soldier accompanying the dog has his gun for.

All commands used in training must be preceded by the dog's name. The trainer must realize he is training the dog to be worked by someone else, and no one should be permitted to make friends with the dog except the handlers. Some work at night during the latter part of training will be required.

Obviously the sentry dog must not be gun-shy. In finding out if a dog is gun-shy you should not fire the gun off right next to him. Have somebody go quite a distance away. At each shot reassure the dog and pet him, until the gunner has gradually come quite close. Most gun-shy dogs have not been properly introduced to gun fire.

As soon as you can locate prospective dogs for Army work, send full particulars to your regional director or to Dogs for Defense, 22 East 60th Street, New York City.

W. Newbold Ely,

Regional Director for Pennsylvania

LETTERS

[illegible] service who cannot otherwise receive the Magazine.—Ed.

• • •

Sirs:

I have now read two copies of your magazine and wish to say that it is the most interesting I have had the pleasure of reading. It is well worth the subscription price. . . .

The following quotation from a letter written me from Sydney, N. S. W., may be of interest:

"As the years go by, the family finds more and more interest in Natural History, and I really believe that it improves from volume to volume. I have just finished reading the February number, which arrived a few days ago, and every article but one was of distinct interest to me. Now and again an article will appear that is of outstanding merit. I have greatly enjoyed George Gaylord Simpson's series on the evolution of animals, and consider the series on strategic metals something of great value. Surely there could be no better way of teaching geography than . . . through this method. R— [a son] used Natural History to provide material for an essay on 'Earthquakes' and found difficulty in breaking off his search for information."

Cincinnati, O. [illegible]

• • •

Sirs:

It is not hard to see why I have continued to make Natural History my annual Christmas gift. For a time . . . I offered my friend a choice of American magazines, but no other was ever suggested, and now I automatically renew Natural History.

Philadelphia, Pa. Frank C. Walsh.

• • •

Sirs:

Your magazine is a work of art, and the beauty of it thrills me every time I receive a new copy. It is priceless, and I consider it a very great privilege to be allowed to renew my subscription.

Mrs. John G. Rodgers

Buffalo, N. Y.

October **NATURAL HISTORY** 1942

Design for Swimming · Attu · Modern Audubon in Mexico

Rainbows of Rock · Mercury · Libyan Desert Exhibi

MEMBERS' CONTEST

$1600 IN U. S. WAR BONDS

to be given to 31 Museum Members who secure the greatest number of new subscriptions

---

The Museum, in war time as well as peace time, symbolizes a vivid reflection of Truth and Human Enlightenment which our liberties have granted us.

Our armed forces are defending this heritage. You can encourage wider knowledge and enjoyment of these American privileges by introducing NATURAL HISTORY to your friends and securing their subscriptions.

Act Today

A fund of $1600 in U. S. War Savings Bonds (face value) has been donated by friends of the Museum to be distributed among those who obtain the greatest number of new NATURAL HISTORY subscribers.

Membership in the Museum is included with each subscription.

Prizes

$500 in U. S. War Savings Bonds for the highest number of subscriptions.

$300 in U. S. War Savings Bonds for the second highest number.

$100 in U. S. War Savings Bonds for the third highest number.

28 prizes of $25 each in U. S. War Savings Bonds for the 28 next highest numbers.

Rules

1. This contest is limited to NATURAL HISTORY Magazine subscribers in the United States. Employees of the American Museum of Natural History and their families, and professional magazine solicitors, are not eligible.

2. To qualify for the contest, you must send in at least three new subscriptions. Each contestant sending in five new subscriptions will receive a one-year renewal of NATURAL HISTORY free.

3. Payment of $4.00 must accompany each subscription.

4. Renewals will not be considered new subscriptions.

5. In case of ties, the tying contestants will be required to submit a letter of not more than 50 words setting forth the merits of NATURAL HISTORY Magazine, and the award will be made to the contestant submitting the best letter.

6. All subscriptions must be received on or before October 10, 1942, or bear the postmark of that date. Winners will be announced in the November issue of NATURAL HISTORY.

7. Envelopes containing subscription forms may be procured from the Membership Secretary.

Contest closes October 10th.

Address all communications to:

Membership Secretary, The American Museum of Natural History,
New York, N. Y.

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COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

[illegible] Antelope
[illegible] American Museum of Natural History

CHARLES FRANCIS PRESS
NEW YORK

LETTERS

SIRS:

In an article entitled "The Largest Known Crocodile" by Barnum Brown in the May, 1942, issue of NATURAL HISTORY, the following statement occurs: "And the largest known fossil tree, measuring fourteen feet in diameter, is from this region."

With due respect to Barnum Brown and the state of Texas, I affirm there is a larger fossil stump or tree, in Montana.

In the northwest corner extension of Yellowstone National Park, on the summit of 9,000-foot Gallatin Range, at the divide between Daly Creek on the Gallatin side and Tom Miner Creek on the Yellowstone side, is a fossil stump approximately nineteen feet in diameter, sixty feet in circumference, and seven feet high above ground.

I am enclosing a photo of the stump I took about 1909 and another showing the Daly Creek basin and part of Gallatin Range, the location of the stump being marked by X. The only way to these fossil trees is by foot or on horseback.

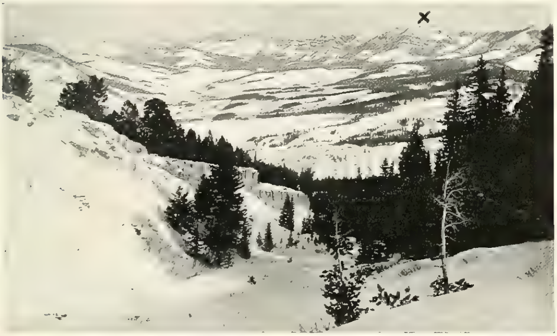
Many large pieces have split off and are lying about. The stump is supposed to be a prehistoric Sequoia. The camera case shown is 9 x 12 inches.

I have been a subscriber to NATURAL HISTORY for many years, and it is my favorite magazine.

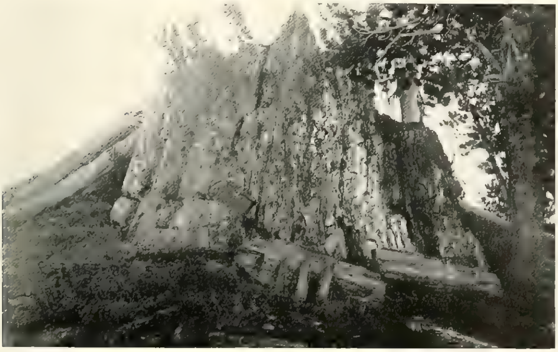
C. A. KINSEY.

Belgrade, Mont.

With apologies for the oversight, NATURAL HISTORY transfers the honor to Montana, where Mr. Kinsey's stump is indeed 18½ feet in diameter by actual measurement.—*Ed.*

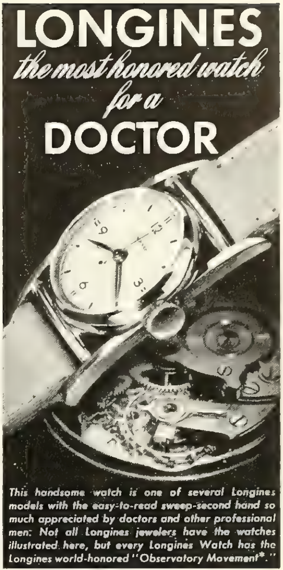


FAR UP in the Gallatin Range, Montana can claim an 18½-foot fossil tree stump, at the point marked X above. It is accessible only by foot or on horseback



MR. KINSEY'S close-up shows the fossil stump and a number of the large pieces that have split off

Continued on page 100


LONGINES
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DOCTOR

This handsome watch is one of several Longines models with the easy-to-read sweep-second hand so much appreciated by doctors and other professional men. Not all Longines jewelers have the watches illustrated here, but every Longines Watch has the Longines world-honored "Observatory Movement."*

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*Trade Mark Registered U. S. Pat. Off.

Longines Watches have won 10 world's fair grand prizes, 28 gold medals

He's firing telephone wire at a Zero!

This fighter plane, with its six wing guns spitting fire, uses up enough copper every minute to make **several miles of telephone line.**

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Right now, our lines are flooded with Long Distance calls. Most of them have to do with the war—they must have the right of way.

Will you help us keep the wires clear for war calls—industrial calls that send a plane down the assembly line—military calls that send it into the air against the enemy?

You can do it by keeping your own calls as few and as brief as possible. And you'll be bringing Victory that much nearer.

Bell Telephone System

NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President ALBERT E. PARR, Director

VOLUME L—No. 3 ★ ★ ★ ★ ★ ★ **OCTOBER, 1942**

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From a Kodachrome by Ralph Calvert, taken near Moab, Utah

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You will find NATURAL HISTORY Magazine indexed in *Reader's Guide to Periodical Literature* in your library

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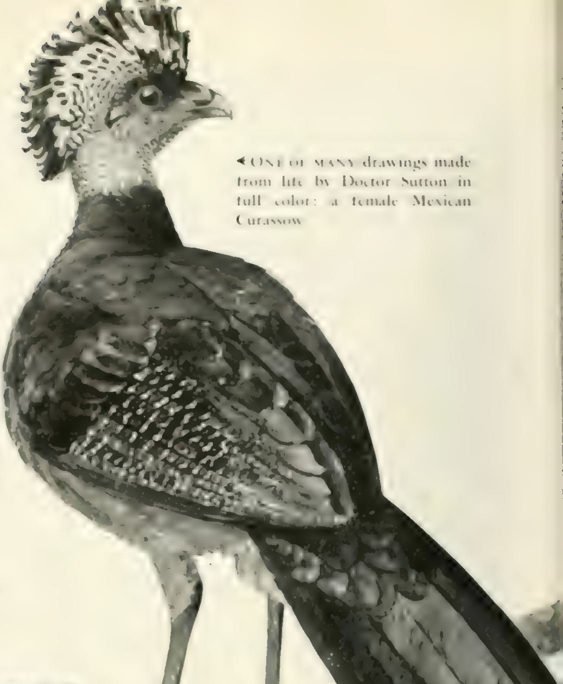


◀ONE OF MANY drawings made from life by Doctor Sutton in full color: a female Mexican Curassow

A MODERN *Audubon* IN MEXICO

An enchanting tropical river beckoned with many unsolved problems in bird study, and four men set out to explore its mysteries

◀UP AND DOWN the lovely Sabinas the four-man Cornell University-Carleton College expedition worked during March, April, and early May. They listed well over 200 species of birds

By GEORGE MIKSCH SUTTON*

Photographs by
OLIN SEWALL PETTINGILL, JR. *and* ROBERT B. LEA

THREE hundred and seventy five miles south of the border town of Laredo, Texas, the Mexican highway crosses a quiet little river. The water is green and not perfectly clear. On very hot days a thin web of light seems to hang low over it. The river moves slowly, as if loath to leave the moss-draped cypresses whose shadows rest so gently upon it.

The sign at the bridge reads "Rio Sabinas." But who could deduce from these words that long-tailed

THE ARTIST putting the finishing touches on a life-size portrait of a Squirrel Cuckoo in the field headquarters. The paint box was used for years by the celebrated artist Louis Fuertes, who gave it to Doctor Sutton

green and gold macaws fly up and down the valley every morning and evening, and that spotted jaguars rear their pretty kittens in impenetrable bamboo brakes back from the cleared lands?

I became acquainted with the Rio Sabinas in March, 1938, when I spent four feverish days collecting birds there with a Carnegie Museum party. We lived at W. H. Bensel's Rancho Rinconada, a partly cleared stretch of flood plain with a one-storied house a mile or so west of the highway.

I fell in love with the Sabinas the instant I saw her. She was so beautiful and clean and cool. The sounds she made were exactly the right sounds. Her shallows were friendly, her shadowy deeps restful to the eye and soul. Even the Vermilion Flycatchers that snatched insects from her glass-smooth surface were the more brilliant because she herself was so delicately green. Standing beside her, I had the strange sensation of being quite comfortable upside-down, so perfectly did she mirror her banks, the gray-boled cypresses, and white piles of clouds.

The Sabinas was a truly Mexican stream. Her whole length lay south of the Tropic of Cancer. Her birds, mammals, bright butterflies, and lizards were austral beings, many of them living here at the northernmost frontier of their range.

Why did they live here? What was it about the Sabinas, or the mountain or forests, that gave them exactly the home they required? When I bade the river farewell three years ago I knew these ques-

---

*George Miksch Sutton has traveled extensively in regions far north of the tropical outpost he describes in this article. He has made two expeditions to Labrador and four to Hudson Bay, and is the author of various books and articles. He has also traveled widely in the U. S., Europe, and western Canada. Much of his time has been devoted to the painting of birds from life, and he has illustrated many books. He has taught at the University of Pittsburgh and Cornell University, and he is the president of the Wilson Ornithological Club.

Olin Sewall Pettingill, Jr., who figures prominently in this narrative, is a previous contributor to Natural History. In 1931 he participated with Doctor Sutton in the Carnegie Museum's memorable hunt for the first eggs of the Harris's Sparrow on the shores of Hudson Bay. He has worked with puffins and Arctic Terns in the Bay of Fundy and has also made bird expeditions to the Dakotas, Florida, the swamps of Louisiana, and the lake region of northern Michigan, between various teaching positions. His bird photographs have thrilled many lecture audiences.

▲ A BOLD ESCARPMENT in the rugged country west of the town of Linares, south of Monterrey

➤ THE EXPEDITION's field headquarters on the Sabinas: a well-screened house of rough timbers on Mr W. H. Bensel's Rancho tions would disturb me until I returned to learn the answers.

I talked with my friend, Olin Sewall Pettingill, Jr., describing the wonderful birds and telling him of the Rancho. He listened attentively, did some figuring, and proposed that we make it a joint enterprise. He would buy a lot of color-film, have his battery of cameras gone over, bundle his belongings into my car, and off we would go. He would assume responsibility for the photographic program. I would center on paintings in water-color, a collection of bird-skins, and certain environmental studies. As assistants we would have Dwain W. Warner, one of my graduate students at Cornell, and Robert B. Lea, a senior at Carleton. Since we did not have room in the car, they would have to make their way to and from Mexico as best they might.

Four necessary permits were obtained from the Mexican Government. I knew we should also have a first-aid kit with iodine, castor oil, gauze, and the like. But what about amoebic dysentery, malaria, and streptococcus infection? The more I pondered, the more medicine I bought. What I finally took was a great bottle of halazone pills for chlorinating water we could not boil, two quarts of quinine, two very complex and expensive antivenin outfits that we fortunately had no occasion to use, and a bottle of sulfathiazole pills for serious cases of blood poisoning, pneumonia, etc. The car was given a thorough going-over. And for my water-color paintings I ordered 50 sheets of the biggest paper I could get, Strathmore three-ply bond, 22 by 29 inches.

We met the boys in Monterrey on February 25th. Lea had traveled from Minnesota by bus. Warner had hitchhiked from Ithaca. They were so excited they hardly knew what they wanted to see most. We first came to grips with birds at our tourist court. Loud cries sounded from the palmettoes outside, pipings, harsh *chacks,* and noises that sounded like cattle trampling on corn stalks. I could not convince my companions that these sounds were all made by one bird; they had to be shown.

Perched high on a palm leaf, wholly unafraid of us, shining like polished steel but disappointing in shape, sat our Great-tailed Grackle. He gave us an appraising look with his pale yellow eye, then suddenly stuck his bill straight up, puffed out his body feathers, spread his wings and tail, shook as if palsied, and delivered himself of a series of squeals that made every one of us laugh. The squealing became a mere fizzing, and stopped. He wore a quizzical expression, as if half aware of the spectacle he had been making of himself. Then he piped with more ardor than ever, and finally produced from his amazing voice-box the sound of breaking stubble that so often had made me turn to see what creature might be stealing upon me.

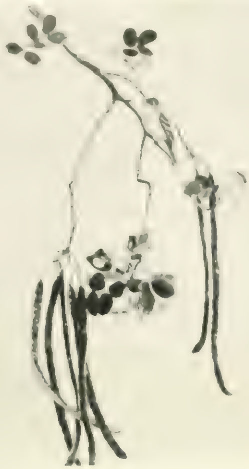
A flock of grackles settled beside him. The males were bent on showing off and clambered to exposed perches. Up went their bills, down went their tails, out swelled their body plumage; their tails spread, their wings waved, and presto! the calliope started. An odd vocal ticking sound was exactly like a child's toy being wound up. They looked as if they were having convulsions, but it was ecstasy. Something seemed to be turning them on and off in twos and

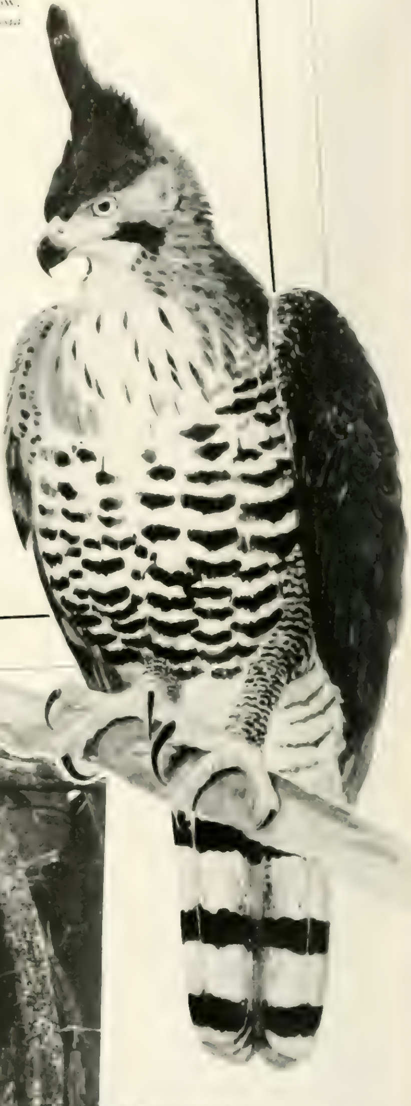
▲ **Trousers** and legs were soon torn when bird life lured the men into the thickets of *huipilla,* or wild pineapple

▲ **The Senora Rodriguez,** who provided the expedition daily with tortillas and carried the wash on a huge platter

▼ **Ramon** chopped weeds diligently with a deadly machete

Two bird PORTRAITS by George Miksch Sutton are shown below, one a Beardless Flycatcher on a flowering and fruiting Cassia branch, the other an austere Ornate Hawk Eagle.



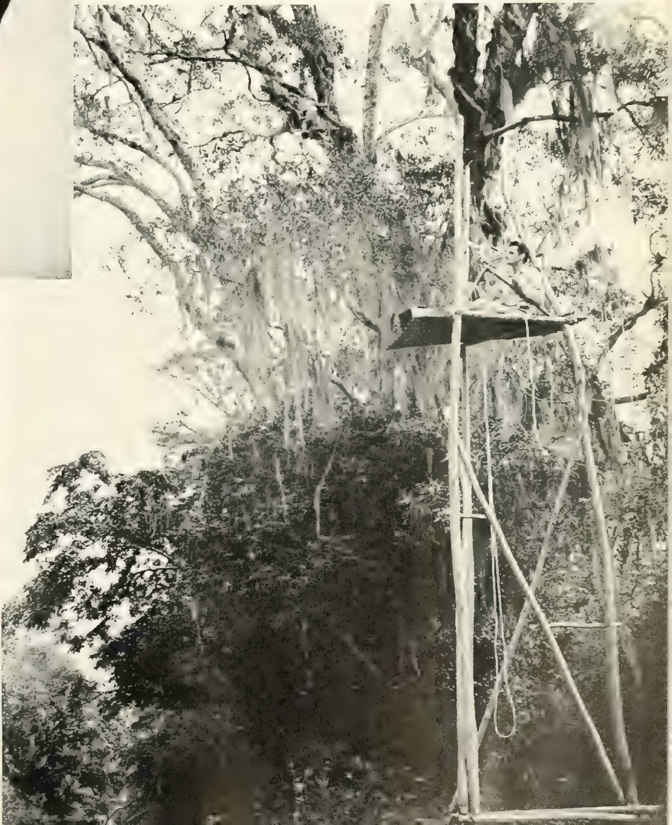


◄ MACLOVIO RODRIGUEZ, guide, philosopher, and friend to the expedition, with Olin Sewall Pettingill, Jr., and George Miksch Sutton *(right)*

◂ A squirrel cuckoo caught at close range by the indefatigable camera of Olin Sewall Pettingill, Jr.

➤ Brilliant red marks the breast of the Coppery-Tailed Trogon, which calls, *"cory, cory, cory"* in a husky, plaintive voice

▲ Branch after branch of the showy *palo de rosa* withered before the artist could paint the background for a colored portrait of the bird shown here, a Masked Tityra



A 20-foot tower rose near the half-built nest of a pair of Rose-Throated Becards when the photographer determined to photograph the process, no matter how wobbly his perch [illegible] They worked like a pack of [illegible] [illegible]

I [illegible] owl

[illegible] owl. Having been in Monterrey frequently in 1938 and [illegible] I [illegible] Park, a few miles north of the city, we might possibly find one.

In this grove my companions saw their first Green [illegible] that trooped from tree to tree, ostensibly foraging for acorns. They screeched incessantly during the early morning hours, directing much of their scolding at each other. They threatened to steal each other's food, liked to play acorn tag, kept sharp lookout for hawks, and lived in the fond hope of finding an owl. Thus we availed ourselves of their services as guides. In a woodland west of [illegible] Park [illegible] chattering announced that [illegible] enemy had been spied. As I walked forward, the hubbub did not subside. Directly beneath the scolding birds at last, I was pleased to see that they did not fly off. Then I noticed that they were dividing their attention between me and a certain hole in a branch about 30 feet above me. Toward this hole they frequently hopped or flew.

With unaided eye I should never have been able to see it. But when I lifted the binocular, there it was, facing me with eartufts half raised and eyes almost shut—a Screech Owl, the very bird we wanted.

If I shot the owl where it crouched, there was danger it might tumble forward into the hole and I should lose it all together. I called Warner. At the sound of my voice the chatter ceased for an instant, but as Warner answered and approached, the jays became more and more excited. They seemed to sense that we were closing in on the enemy.

Warner began throwing stones, which whirred just past the owl's face and at last struck the cavity itself. Out flew the owl. From somewhere a jay swooped down, screaming at the top of its voice. The owl halted, changed its course, and disappeared as if by magic. Annoyed because I had not shot when I had the chance, I followed. Again jay voices told me where the owl was, for they cried out as long as it was in flight. When it settled, I approached with considerable care. It flew out, and this time making off directly. I aimed and shot it. Without the help of the jays, I would not have got that valuable specimen.

Green Jays have good reasons for not liking owls, but they sometimes mob an innocent creature apparently for pure fun or deviltry. While walking through a cat's-claw tangle we chanced to put up a soft-winged night-bird known as Merrill's Pauraque. This is a goatsucker, and goatsuckers and owls had a common ancestor not too many ages back. It looked a good deal like an owl, save that it squatted. We put it up twice, but we wanted especially to see it on the ground. Finally, to our surprise, it circled and re[illegible]. With the glass we could study its markings to our hearts' [illegible] brown with delicate arrowhead-shaped spots of black on its back and shoulders.

[illegible] the Green Jays stole in from far and near, to rail at this poor creature that never in its life had harmed a jay. They darted at it, scolding violently, but did not alight on the ground near it. The poor pauraque took their insults with dignity, never batting an eye.

During our two busy, drizzly days at Monterrey [illegible] all [illegible] birds and saw one lovely species I had never seen before—the White-tailed Kite. Moving on to Linares, we undertook to make a complete list of the birds, which meant hunting in all sorts of country, by night as well as by day. Here the Brown Jays became our self-appointed vigilantes. Withersoever we walked, they accompanied us, screaming almost incessantly and saving their vilest language for those times when we most wanted quiet. When one flock discovered us, other flocks came flopping comically through the air with their tails bobbing, screaming until our heads rang.

The Brown Jay has one anatomical feature that is, so far as I know, unique. On the chest there is a curious little bag that is inflated with air when the bird screams. It fills or collapses so explosively that the jay seemes to hiccup. The Mexicans call this jay the *Papán,* in imitation of the hiccup.

Rough going

Fifteen miles west of Linares the mountains rise abruptly. A road which follows a tortuous canyon bed for miles and miles leads through these to Galeana. No sooner did Lea and Warner hear of Galeana than they wanted to go there. A wild place was what they wanted—something well off the beaten track. I had been advised not to drive to Galeana, but the more the boys talked the more curious I became. Just how bad was that road?

It was unbelievable. Lea, Warner, and I jammed ourselves into my Plymouth with a young Mexican interpreter named Octavio and climbed the boulder-strewn canyon, across puddles and streams, along the faces of cliffs, through breath-taking defiles. The turns and dips were like jackknife dives. After twenty miles I doubted that we'd make it. At one place we rounded a boulder to find ourselves face to face with the Army. After looking at us boldly the 60 or 70 cavalrymen separated and let us by.

At Galeana, Lea and Warner were introduced to the *Presidente* and extended a welcome. At the little hotel they took a room, which had no rug, chair, nor door-key, but was just the thing their adventurous spirits wanted. Arranging to meet them a week hence in Mante, where they would go by bus, I bade them good-bye and rejoined Pettingill.

He and I proceeded to the Rancho, wondering what was in store for us. Would we find it possible to live there and accomplish the photographic and life history work we wanted to do? And the road to the Rancho—what about that? A hundred yards or so from the highway this road crossed an arroyo, impassable in the rainy season. When did the rainy season begin, and how much rain did it take to make this a raging torrent or a mud hole?

On March 13 we tackled it. The stream-bed itself was firm, the water a mere trickle, but in climbing out I kept too near the edge of the road, and the soft shoulder gave way. For one awful moment I thought we were in for a turning over. As it was, I managed to back straight down the embankment, thus righting the car. But something went wrong with the gas-feeding apparatus, and the half-hour of starting an engine that repeatedly sputtered, whirred, and died, was a soul-trying experience. Finally the engine purred as if nothing had been wrong, and on we went.

Among old friends

At the Rancho we were welcomed by good old Maclovio Rodriguez, Mr. Bensel's tenant, who remembered me and gestured with a smile toward the "red rocks" on the mountain where three years before he and I had hunted curassows. His *Señora* padded forward on bare feet to greet us amiably, and a seven-year-old grandson, Ramón, waited in the offing for the grown-up ceremonies to be completed.

Maclovio set to work with his machete cutting weeds in the doorway. The place had not been in use since we had been there in 1938. The house had a sitting room and bedroom in front, a little kitchen and bathroom behind them, and a store room and porch at the rear. The well-screened windows had swinging shutters, the walls were plaster, and the floor cement.

A thorough cleaning was necessary. Under a table in the store room was a termite's nest as big as a wash tub, a dark brown, shapeless, sinister object. The insects had built their covered runways on the walls, floor, and ceiling. Some of the tubes hung down three or four feet. Mr. Bensel hacked the nest from its moorings, dragged it outdoors, saturated it with kerosene, and set it on fire.

Frisky lizards of several kinds lived in the house, but their faces were so bright and their ways so innocent that we enjoyed having them. We were astonished at the abundance of mice, gray creatures with lambent, dark eyes, big, round, thin ears, and white underparts. They were in the mattress, the bureau drawers, closets, and kitchen. They were exceedingly gentle, and we did not want to kill them, but we knew we could not risk having our bird-skins damaged and that a trapping campaign would be necessary.

We decided to cook for ourselves, thus keeping our household down to four. The *Señora* would, however, prepare a pot of frijoles and a pile of *tortillas* for us daily in the Rodriguez ménage back of our own. Maclovio would bring a supply of water from the river each day, provide stove wood, and assist in building observation blinds.

Pettingill had just given the fourth bureau drawer the scrubbing of its life when two ear-splitting squawks sounded outside. Recognizing them I ran out, shouting to Pettingill to follow. Two Military Macaws, green with golden wing linings, were flying deliberately down river, the sunlight imparting a turquoise shimmer to their pointed wings and long tails. Watching them did us both good.

That first night at the Rancho was astonishingly cold. We were chilly in spite of one heavy and one light blanket; and poor Mr. Bensel must have been miserable stretched out on a bench with only topcoats. An animal, probably an opossum, crunched bones near the house, and our entire mouse population was abroad. They were quiet and gentle-mannered, but I could hear tinkling as they ran about the bed, and once so many of them crowded on a poorly anchored shelf that the whole thing came down with a crash. Lying awake, I was grateful that we had reached the Rancho without serious mishap; that malarial mosquitoes would not prosper in weather such as this.

Next morning Pettingill and I saw immense flocks of Red-crowned Parrots milling about certain tall *ox* (pronounced *osh*) trees near the river. Their flight was rapid, like that of ibises or wild ducks. Often they flew about in pairs, and they did some of their courting in mid-air, screeching and clawing, and fluttering upward as if climbing an invisible wire, facing each other. They were eating the *ox* buds and flowers but losing about nine-tenths, and the sound was like falling rain.

When we approached the parrots, they peered down at us suspiciously with their round orange eyes, making comments about us *sotto voce*. Then, convinced that we were foes, they shot out through the leaves, yelling as if possessed of seven devils.

Three other members of the parrot tribe lived near the Rancho; the not very common Yellow-head (said to be the best talker of them all), and two Sharp-tailed Parakeets—the Green and the Aztec. All the parrots were hard on the crops. Lacking guns, most of the natives were obliged to throw stones or use sling-shots. It was said to be possible to frighten the Red-crowns off by shouting or tossing a pebble or two. But the tough macaws were in no hurry to depart. Squawking hoarsely, they would lean down, deliberately tear loose a whole ear of corn, and fly off with it in their bills.

There were mammals in this country too—armadillos that fared forth at dusk, fearless coati mondis that foraged noisily by broad daylight, White-tailed deer, even jaguars.

The good river

Pettingill and I took our shoes and socks off and waded in the river. Ah, I thought, it's good to be back. The river has not changed. She is friendly and gentle and cool. A wild Muscovy Duck, big as a goose, flapped majestically down stream. On the forest floor beyond the river, the tinamous whistled. Gorgeous black, white, and flame-orange Alta Mira Orioles trooped through the tree-tops. A Coppery-tailed Trogon called *"cory, cory, cory,"* in a husky, plaintive voice that reminded us of a hen turkey's. Off in the distance a Guatemalan Ivory-billed Woodpecker rapped a challenge on a cypress stub. Wherever we went there were butterflies of brilliant colors, and one lovely gray and purple one even followed us about, waiting for a chance to alight upon us.

In mid-morning, along the Gomez Farias trail,

▲ A BLACK VULTURE, or *zopilote*, on its nest

▲ THE MOST SPECTACULAR game bird of the region, the Mexican Curassow, or *Faisano Real*. The expedition discovered a nest of this fine bird during the first few days near the Rio Sabinas

▼ ROBERT B. LEA, of Carleton College, ready for a side trip

▼ DRINKING cool, fresh water from a section of *parra* vin

▲ THE PHOTOGRAPHER and lecturer, Olin Sewall Pettingill, Jr., prepared for action with color film and telephoto lens

➤ THE RANCHO'S BUTTERFLIES were as brilliant as its birds. Here is a lemon yellow and black Heliconiid, sipping at a flame-colored blossom

▼ DWAIN W. WARNER, who hitchhiked to get there and didn't miss much after he arrived

[illegible]

"[illegible]," Pettingill suggested. "Or driving something out!"

Indeed, they appeared to be on the war path. Their glistening antennae looked not unlike tiny swords brandished in the air.

Suddenly in their very midst, we spied a four-inch scorpion, moving forward slowly, flicking its poison-[illegible] quivering tail, sank, and moved no more.

Toward noon, off in the gray-green tangle between me and the river, I heard the solemn *oomp, oomp* of [illegible] Mexican Curassow. How vividly I remembered collecting my first specimen of the far-famed bird—when I had not had time or paper to make more than a quick sketch of its tousled head. Now I had both aplenty, and a drawing of this biggest of Tamaulipas birds was part of my plan.

It is impossible to go through a *huipilla* (wild pineapple) thicket silently, but I had to get that *Faisano*. [illegible] I had taken [illegible] steps. And for every snag in the [illegible] there was a corresponding snag in me.

Deep in the thicket, I remembered that no sound of the Mexican wilderness is more ventriloquistic than that of a courting *Faisano*. The sound throbbed oddly, as if only a few inches from my ears. Then it seemed to come from high on the mountainside, or from the river. It seemed to be under foot!

Suddenly there was a crackling of branches almost overhead as the heavy black and white bird left its perch. Had I known less about the power of my gun, I'd simply have groaned and watched the magnificent bird flap away. But I had hunted some of America's swiftest birds and the gun came up automatically. There was a fierce roar, and the *Faisano* crashed into the [illegible]. Pettingill had also been attracted by its booming and heard it fall.

Heedless of the armored thicket, I ran forward. It was an all-important moment for me as a bird artist. The *Faisano's* face would have all the colors of life; in five minutes it would not. What oddly beautiful, recurved feathers were those of that barbaric top-knot! How strange the pattern of black and yellow and grayish ivory on the bill! Lifting my prize, I decided it must weigh eight or ten pounds, perhaps more.

Pettingill's eyes were shining, for he too had been finding things. He had collected a beautiful Brown Woodhewer, a bird he had never before seen alive [illegible]

[illegible] my *Faisano*, I made quick pencil [illegible] then worked out the plumage of the head, color patterns of the face and bill, and scalation of the feet, in great detail. This took several hours—all the daylight I had that afternoon. The paper was damp and not quite flat, the paint was sticky, and my strokes wouldn't dry fast enough. There is nothing so maddening to a water-colorist as slowing down to accommodate humidity. In achieving the soft glossiness of the neck I had to put [illegible] stand away for five minutes or so to keep from touching some wet spot and ruining the effect.

We were growing a bit anxious about Warner and Lea, for we had not heard from them. The rain might flood the arroyo and cut us off from the highway. By this time we had been bitten in a thousand places by ticks and had to divide our energies between scratching and work.

The next morning was somewhat drier, so I set off for the foot of the mountain to get the part of the tree on which my *Faisano* had been *oomping*. That meant more snags and ticks, but by 10 o'clock the drawing was finished. The bird itself was then skinned and stuffed.

Lea and Warner arrived that afternoon, bursting with tales of Galeana. The whole community had been courteous and co-operative, and they had obtained a good bird collection.

So this was the Rancho! Why, it was a thousand times better than they had dreamed! A sure-enough kitchen, a dining table, kerosene lamps, and screens, —think of it! Walking to the river and back, Lea grew downright hilarious. "Honest to goodness, Doc," he shouted. "It's wonderful here! I'm in glory!"

There was much to be done,—nests to find, blinds to build, trails to cut. Maclovio's son, a fine young man named Pepe, bridged the shallows just below the swimming hole with great sections of tree trunk. Maclovio widened all the nearer trails and even little Ramón helped, chopping weeds with a formidable machete almost as long as himself.

Lea was Pettingill's assistant, Warner mine; and the place bustled with activity. Lines of traps were set for small mammals; lizards were occasionally captured. It was our custom to finish each day's skinning and painting well before dark, write notes after the evening meal, then take a turn with gun and flashlight for night birds.

One eerie night, when one of us chanced to open a shutter, we discovered that the house was fairly crawling with scorpions. I saw one on the wall and killed it with a cane. Then I spied an even larger one, clinging to a rafter directly over the bed. By this time everybody was up. We found several more, some of them thin little half-grown ones. From that night on, scorpion hunting was part of retiring.

Bird painting was not all fun. I grew terribly tired of sitting hours at a stretch, intent on recording color and shape accurately. But the series of portraits grew steadily. I was able to paint some of my birds directly from life, but as a rule I hunted in the morning and brought the bird back as quickly as possible in order to paint the bill, feet, and eyes before any color faded.

Late one afternoon Bob Lea came in with one of the oddest birds I ever saw. It was a Boat-billed Heron. I was so sick of painting that I would gladly have seen that heron rise up and flap off, but here was a chance that might not come again, so I got a clean sheet of paper and set to work. Darkness fell long before I had completed the picture. But in the

▲ STICKING TO HER GUNS though the camera is only two feet away: a female Buff-bellied Hummingbird on her nest

▲ A NOISY AND NOTICEABLE BIRD photographed at its partly built nest: a Texas Derby Flycatcher. Building the nest required 24 days

◄ EXOTIC BLOSSOMS livened the slopes of the mist-drenched mountains with their color and fragrance: a Passion Flower

▼ HIS COUSINS, the dinosaurs, were among the largest creatures that ever lived: a Mexican iguana. Lizards were abundant about the Rancho house

[illegible] almost conical, bill.

[illegible] *palo de rosa* withered before I could paint them in [illegible] back to the "studio" before the petals wilted.

Each bird took from three to eight hours to paint, not counting trips out and back and hunting time. One bird represented more man-hours than all the others combined, because it was so difficult to find [illegible] ing what it was. Getting one of these birds became a sort of mania with me. I haunted the rough slopes in all sorts of weather, leaving the Rancho at melodramatically early hours, toiling up the acclivities in fog and rain and sizzling sun, returning sometimes well after dark.

[illegible] and, peering through the maze of vines, caught a [illegible] were really quail, then; but to what species did they belong?

And it was Pettingill who got the first specimens, [illegible]

Pettingill's specimens, shot at close range, were somewhat damaged. Needing one more, I went after it at once. I reached the rocks that the birds fre- [illegible] A single [illegible] I did not fire. Then, not more than a yard from my feet, I saw the bright face of a female quail.

To collect this bird properly I would have to back off ten or twelve paces, or risk trying for it on the [illegible] I did not put the bird to flight. At fair distance I shot, securing a perfect specimen. Then I discovered, partly to my sorrow, partly to my great elation, two baby quail that she had been brooding—possibly the first baby Singing Quail ever to be collected by a bird-artist. My painting shows the family together: father, mother, and two babies.

Poor Pettingill had mean weather for his color photography. He tried to be cheerful, chased butterflies, watched birds from his blinds, and wrote voluminous notes; but the photographer in him was sick. When he discovered a beautiful female curassow nesting on her two big white eggs, he sat hour after hour for days, hunched up in his little blind. A color record of these fine birds in action would have been welcomed by zoologists the world over. But the sun did not come out; and one night some unholy varmint ate the eggs. Pettingill came home looking gray—like the weather.

However, we had a fine ten-day stretch early in April and Pettingill was like a spring lamb. There were parrots in the bamboo to photograph, herons fishing for helgramites, doves pumping up milk for their babies, flying macaws, and woodpeckers at [illegible] 20-foot tower rose near the half-built nest of a pair of Rose-throated Becards. Pettingill had tried photographing the great globular structure from a high branch, but the whole set-up was dangerous for both [illegible] on the other hand, a Hooded Oriole insisted on building her nest inside the green cloth blind, coming and [illegible] in, dragging the nest material after her.

Out on the highway that led to Mante the [illegible] toward our camp and mountain, we could see the white, thick cloud that constantly hung there. In it, back among the *jobo* and *ox* trees where the parrots fed, the world was gray, fog-hung, dripping. This cloud resulted from the cooling of warm air that rose from the Sabinas valley. It retained the same shape week after week even during the comparatively rainless part of the year. Moisture in so warm a place meant luxuriant vegetation, and luxuriant vegetation meant birds, hence their abundance and variety and the presence of several species that could live only where such vegetation throve. That was the answer, in its simplest form, to the question that had stirred my curiosity ever since my first visit to the Rancho. Our Rancho country was, in other words, a slender arm of the deep tropics reaching northward along the very base of the Sierra Madre Oriental.

We recorded representative species of four distinctly and exclusively neotropical bird families. These were the Nyctibiidae, or Potoos; the Cyclarhidae or Pepper Shrikes, the Cochleariidae or Boat-billed Herons; and the Formicariidae, or Ant Birds. So far as we have been able to learn, not one of these has ever been taken as far north as the Tropic of Cancer.

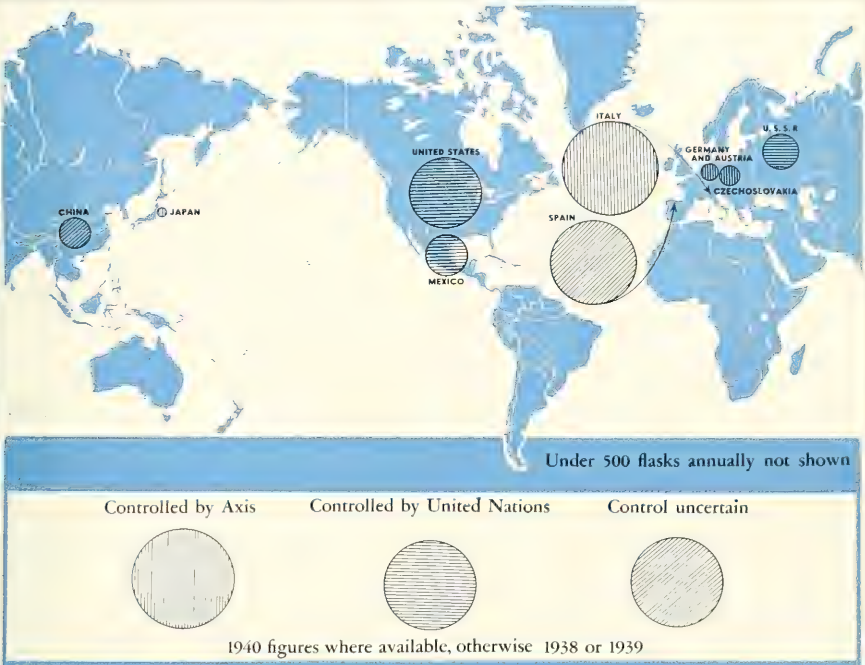
With literally hundreds of birds, lizards, mammals, and insects to be packed, our last few days were something of a nightmare. By this time one of the cameras refused to work; the sights of the combination rifle-shotgun were out of adjustment; and something was wrong with the car's ignition system. On April 26 it started to rain, thunderously. We closed the shutters. The world grew dismally dark. The paths ran water. The river rose. Pepe came to tell us that our bridge had gone. I pictured our poor little car, dragged by oxen, moving ever more slowly across the flooded arroyo, and a last desperate effort to save our specimens even if the car should drift away.

On the third day of the river's steady rising, May 2 we decided to leave as quickly as possible with chains on the car. The river was good to us. In spite of its bad reputation and our anxiety to the very last, we crossed the arroyo without serious difficulty.

Glancing back across the steaming *huisache* thicket toward our mountain, we bade farewell to the Rancho cloud and the tangled slopes it shielded, where black-spotted yellow orchids, baby Singing Quail, and drowsy Potoos found refuge from the fierce sun. Our lives had for a time been lived there. Remembering what we had learned of that fascinating world, we would continue to feel a part of it, however far away.

STRATEGIC METALS

NUMBER VIII


ITALY
U. S. S. R
GERMANY AND AUSTRIA
CZECHOSLOVAKIA
UNITED STATES
SPAIN
CHINA
JAPAN
MEXICO
Under 500 flasks annually not shown
Controlled by Axis
Controlled by United Nations
Control uncertain
1940 figures where available, otherwise 1938 or 1939

Production of MERCURY

Well-known to the ancients as the mysterious "liquid-metal," mercury is a vital ingredient in medicines and bombs—and the Axis has no shortage of it.

By Frederick H. Pough

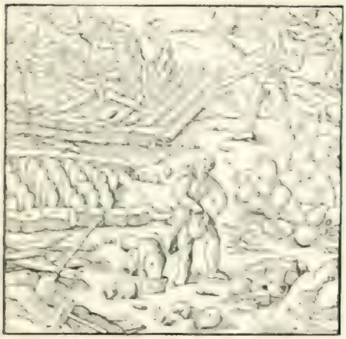
Chairman and Acting Curator, Geology and Mineralogy, The American Museum of Natural History

NO metal illustrates more markedly the contrasting situations of different nations as to strategic minerals than mercury. We need have no illusions about an Axis shortage of mercury, for Italy and Spain have long been the world's main producers of this remarkable metal. We, on the other hand, have a real problem in obtaining sufficient mercury for our needs, and when this war is over we may find most of our deposits exhausted.

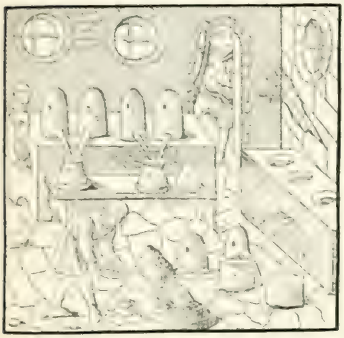
The popular name for mercury, quicksilver, is the older and can be traced back to the Greeks. The ancients called it *argentum vivum* ("living silver") or *hydrargyrum* ("water silver"), depending upon whether it was found in a native state or purified from the ore. A belief that one type was better than the other continued until recent times in the popular mind. The early miners of California, who recovered gold by amalgamation with mercury, paid a premium for the native mercury on the theory that it functioned more efficiently. The modern name, mercury, is no doubt a result of the medieval custom of assigning a planet to each of the common metals. The planet Mercury, named for the fleet-footed god, was certainly appropriate for quicksilver. The chemical symbol, Hg, however, refers to the ancient name.

Mercury was doubtless known even in prehistoric times. Its ore was one of the very earliest substances used by primitive peoples, for its brilliant red color would soon attract their attention. Being soft, it readily lends itself to use as a pigment, and the earliest use was probably as rouge or body paint. The Chinese also have records of the use of the metal as early as 210 B. C., while Aristotle speaks of it over 100 years earlier.

Its remarkable appearance as a liquid metal endowed it with mysterious and unique properties, and it naturally re-



Ore was put in upper of two pots, separated by moss and sealed with clay. Heat distilled Hg into lower pot



In another method, the quicksilver fumes from furnace pots (A) passed through nozzles (C) to condense in the gourd-shaped vessels (D)

Methods of distilling mercury in the 16th century are shown at left and right from Agricola's woodcuts in his *De Re Metallica*. Herbert Hoover's translation of this ancient classic is a notable contribution to the history of mineral science

[illegible] the attention of the alchemists of the Middle Ages. One of the best known, Geber [illegible], believed that all metals were made of mixtures of sulphur and mercury, and the search for a method of transmuting other metals to gold can no doubt be laid to the wide acceptance of this theory.

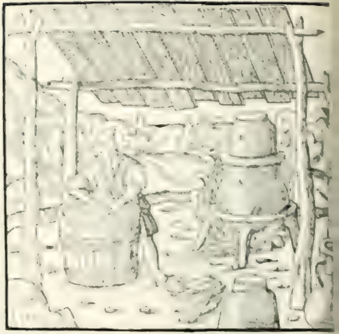
There is but one ore of mercury, the sulphide cinnabar. Numerous other mercury minerals are often associated with cinnabar in deposits, and the native metal is commonly found in small drops in cavities, but none is important in quantity. Cinnabar is bright red in color and is one of the most striking minerals for the collection. Usually it forms in solid masses in the rock; crystals are not very common. Lean ore may show thin stringers and splotches [illegible] pure cinnabar. The rich color of cinnabar makes it a fine coloring agent [illegible] and Western collectors often cut and polish small pieces of this cinnabar-impregnated [illegible]. Unfortunately pure cinnabar is far too soft for such use.

Separation of the sulphur from the mercury is now a very simple process, but the earliest method of purification was far more complex. Theophrastus, writing in about 300 B.C., says that quicksilver "... is obtained from native cinnabar, rubbed with vinegar in a brass mortar with a brass pestle." Soon, however, the modern method of heating the ore to oxidize the sulphur and vaporize the mercury was developed, and Agricola (1494–1555) describes five different systems by which this may be accomplished. He cautions repeatedly about the danger of the escape of the mercury vapor and warns that much will be lost if the containers are not carefully sealed.

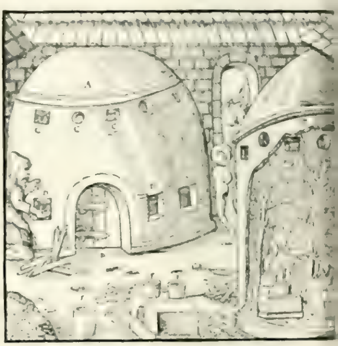
In all of the early methods, the material was handled in batches. Today the process is continuous. The ore passes through a furnace in a steady stream, and as the mercury vapors rise they pass through a series of cooling pipes. The mercury is drawn off at low places where it has collected and is loaded into standard 76-pound iron flasks, in which it is sold. Further purification can be achieved by redistillation, if necessary. The recovery of mercury is such a relatively simple and inexpensive process that it permits the operation of small deposits and the treatment of the ore in small stills on the spot. The method is in marked contrast to the requirements of some of our other strategic metals, like tungsten and chromium.

Cinnabar and stibnite are common associates in ore veins and in mineralized regions. From this we may infer that mercury ore, like antimony ore, is a mineral which is carried far from the igneous source of the ore body, and we expect to find them in regions which are in their geological youth, where volcanic activity occurred in the not distant past. In this country then, we look again to our West and find that mercury deposits are characteristic of Texas, Nevada, California, and Oregon. Many other states have produced some mercury, and under today's stresses, deposits which could not be worked under the old price of $75.00 a flask become valuable deposits at $199.00.

California has long been the leading producer of mercury in this country. Its mines were worked in the early days of mining in that state to procure mercury for the separation of gold. It was then said that in order to work a gold mine, one must first have a mercury mine. In 1940, California was responsible for 49% of our national production. In that year, nine states and



Sometimes the ore was covered with sand or ashes. Vapors sought refuge in upper jar; mercury fell into sand



The sloping floor of these condensing chambers collected the droplets which fell from the cool leafy branches put there to assist condensation

Alaska produced almost 38,000 flasks; we may be sure that the production today is higher, with high prices offering a new incentive.

That the Italian and Spanish deposits have been dominant for many years—in fact, ever since the days of the Romans—, is implied in the names of some of the California mines. The New Almaden and the New Idria mines are the big California producers, while Spain's Almaden and Italy's Idria are the world's principal producers. In 1938, the last year for which figures are available, the world produced over 140,000 flasks of mercury, of which Italy produced almost half. Spain has been producing approximately half of the remainder, and while little is known of today's yields, we may be sure that they are ample for all Axis needs. In 1940 the United States produced about 38,000 flasks of mercury, and consumed about 10,000 less. At that time it was estimated that the known mines of the country could produce, at $175.00, about a three-year supply.

The uses of mercury are many and varied. It is the only common metal which remains liquid at ordinary temperatures, and does not solidify until cooled to −39°F. It was not until the winter of 1759-60 that Professor Braune of St. Petersburg succeeded in solidifying mercury, and from that date it was accepted as a true metal. Some of its uses depend upon its fluidity at normal temperatures and its expansion and contraction at regular rates, as in thermometers; but the chemical uses, especially the poisonous ones, may be considered more important. Because so many of its compounds are poisonous, mercury is widely used in medicines and drugs. In 1928, one of the few years for which statistics are available, almost 40% went into such compounds.

More of the highly explosive fulminate of mercury (a compound with carbon, nitrogen, and oxygen) was manfactured during the peacetime year of 1928 than in 1917. Fulminate of mercury is easily exploded by impact and is therefore an ingredient in detonators. But because it releases its energy so rapidly that it will not fire a gunpowder charge under normal conditions, it is mixed with a diluent (one constituent of which is the stibnite of which we spoke as an ore of antimony) to slow up its action until the gunpowder can be ignited.

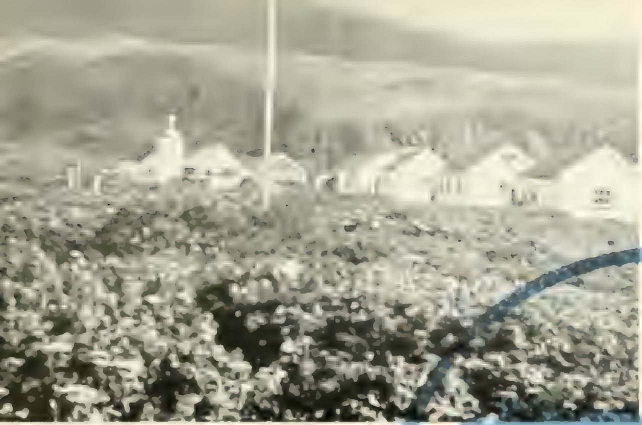
The use of mercury in pigments is important; it makes the vermilion color of paints and inks. The oxide is used in marine paints and is, of course, an important naval use in wartime. Its value lies in its faculty of forming with sea water the poisonous corrosive sublimate, which is fatal to barnacles that might otherwise attach themselves to the hulls of boats. Another compound is used in softening the hairs that are matted together to make felt.

Deep red cinnabar crystals, from a Jugoslavian mine. Crystals like these are rare, however; the ore is usually massive. Its bright color makes cinnabar one of the most striking minerals for the collector

AMNH photo by Burwert

Certain scientific and electrical instruments require the use of mercury, especially in switches that are made to operate only when they are in the desired position. The mercury closes the circuit when the capsule containing it is tilted; otherwise no current can pass through. The ancient use, the amalgamation with gold and silver, is reassuming importance in the recovery of gold, but this use, like some others, does not result in the loss of much mercury, for almost all is recovered in each disstillation. An important use, which will surely now have to wait until the military needs for mercury are less urgent, is in the production of electrical power from turbines driven by mercury vapor in place of steam. Here the same mercury is used over and over again, but large quantities are needed for each installation. Operating at higher temperatures, these turbines give far greater efficiency in fuel utilization and at the same time permit steam to be heated in the same boilers. The mercury vapor, after giving off its power, can also be used to heat more steam, which can in turn generate electrical power. Since the initial mercury investment is high, it is improbable that any new installations will be available to this country until the war is over, but it is a promising new field for mercury in the future.

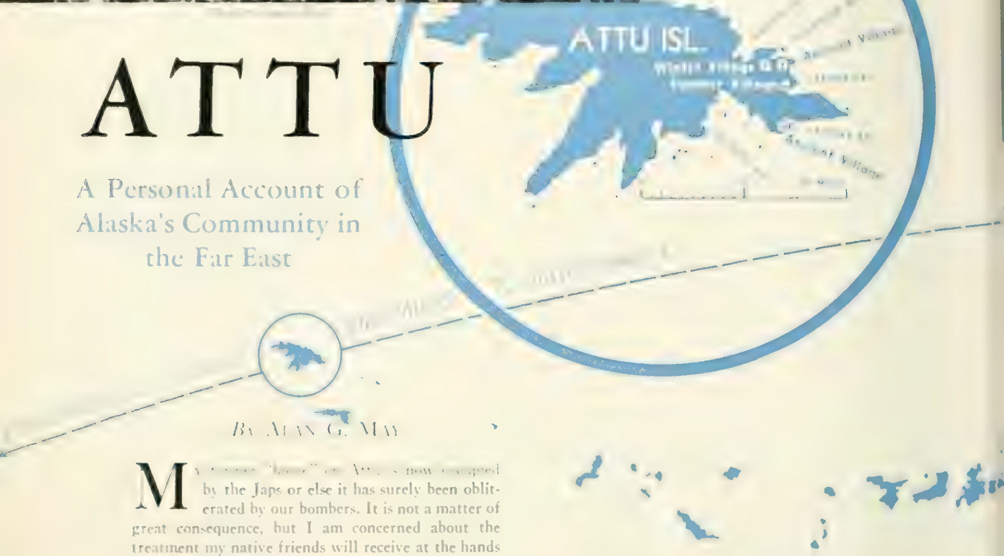
The American situation with regard to mercury is really very serious. We have prospects of getting larger and larger supplies from Mexico, and perhaps a little from South America, but it is more likely that we shall curtail non-essential uses. Mercury boilers are efficient, it is true, but their discontinuation would release large quantities of mercury for other uses. Felt hats could be eliminated; vermilion is certainly dispensable. Other disinfectants could take the place of mercury compounds; other paints are also antifouling. Lead or silver fulminates might possibly take the place of mercury in the field where it is most essential until this war is won, but probably no such stringent measures will be necessary. Meanwhile we are working our deposits to the limit and getting a good supply of mercury, but Uncle Sam had better not get into another war after this one, without a good reserve of mercury safely tucked away for use —unless he has some good "Buck Rogers' disintegrators" to use in place of explosives.



◄ The village of Attu, now in Japanese hands, had 45 inhabitants, all Aleuts of mixed blood. The Russian Greek Orthodox church is an excellent building, but there was no resident priest; the village Chief led the services

ATTU

A Personal Account of Alaska's Community in the Far East



By Alan G. May

My former "home" on Attu is now occupied by the Japs or else it has surely been obliterated by our bombers. It is not a matter of great consequence, but I am concerned about the treatment my native friends will receive at the hands of the Japanese.

When I arrived in the village of Attu in 1936 the problem of where to live for the duration of my stay was immediately solved by the little Chief who suggested that I move into the schoolhouse. This was by far the largest building on the island and I was astounded to find it contained two schoolrooms, two bedrooms, two kitchens and, strangest of all, a modern bathroom complete with fixtures. One bedroom I found furnished with all the necessities except blankets, and one kitchen was completely furnished even down to crockery and kitchen utensils. I learned later that there had never been a school teacher on the island and that the natives did not want one. Anyway there were only four or five children of school age.

I had come out with a party to make archaeological investigations under the leadership of Dr. Ales Hrdlicka of the Smithsonian Institution, and while he and the others were excavating on Kiska I had been permitted to go on farther west to work on Attu. Here I was left by the United States Coast Guard Cutter "Shoshone," the lone white man on the island. It was possible for our party to reach these inaccessible islands only through the fine co-operation of the United States Coast Guard.

I found that many of the natives knew no English; four or five of them knew an odd word or two. The Chief, however, spoke broken English exceedingly fast—so fast that I found it hard to understand him at first; but later I was able to carry on long conversations with him, and he indeed proved himself a friend in need.

Attu is the most westerly of the rocky, treeless Aleutian Islands and has the distinction of being the only inhabited Alaskan island in the Eastern Hemisphere. It is approximately 30 by 40 miles in size,

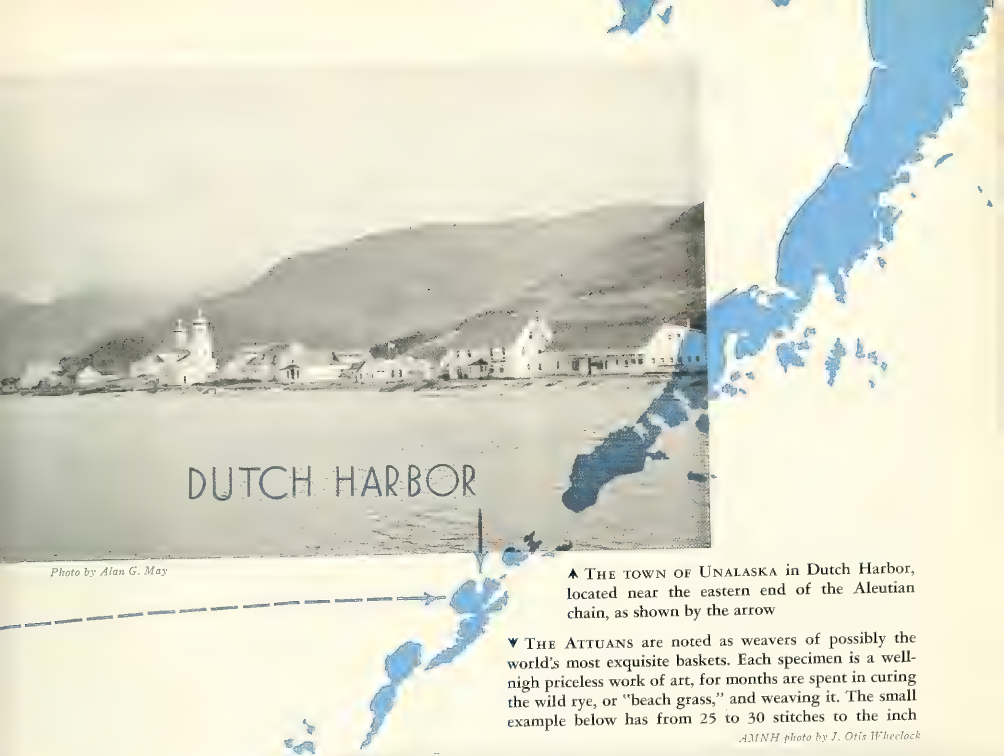


Photo by Alan G. May

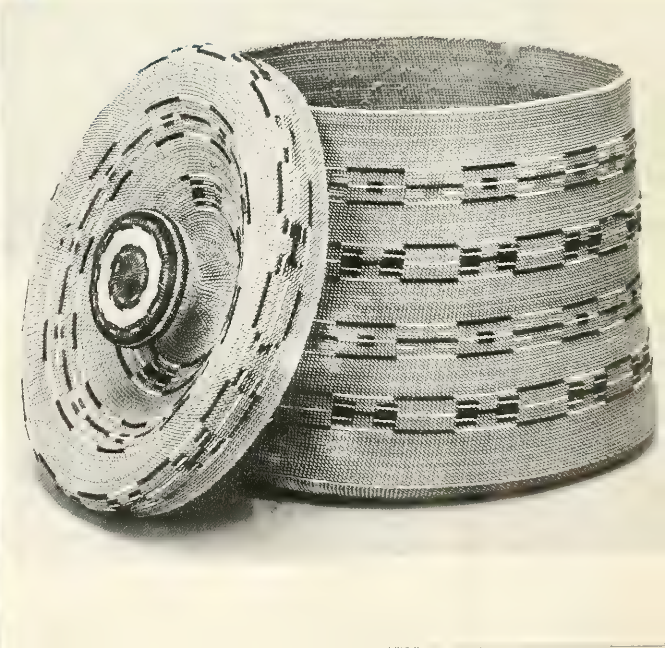
▲ THE TOWN OF UNALASKA in Dutch Harbor, located near the eastern end of the Aleutian chain, as shown by the arrow

▼ THE ATTUANS are noted as weavers of possibly the world's most exquisite baskets. Each specimen is a well-nigh priceless work of art, for months are spent in curing the wild rye, or "beach grass," and weaving it. The small example below has from 25 to 30 stitches to the inch

AMNH photo by J. Otis Wheelock

▼ THE CHIEF'S wife, working on one of the famous baskets

Photo by Alan G. May



[illegible] weather conditions native flowers grow profusely.

[illegible]

[illegible] from the deck to the shore on either side. On several [illegible] me with the greatest admiration for the competence [illegible] of the officers and men of the United States Coast Guard. The harbor itself has more the appearance of an inland lake, with the village of Attu at the far end.

The inhabitants of this little community of 41 men, women, and children are all Aleuts of mixed blood. It is doubtful if any pure-blooded Aleuts still exist.

One evening, after I had been on the island several days I [illegible] callers. They were Leon and Fede (pronounced Fay-de-say) Hodikoff, both nephews of the Chief. Their combined knowledge of English was about equal to my knowledge of Aleutian, which was [illegible] words. I offered them chairs and there we sat smiling at each other. Nothing happened. I found the situation rather absurd. If we could not converse, then at least we could eat, so I brought out some crackers and made a pot of tea. This consumed, they pulled some archaeological specimens from their pockets and presented them to me,—evidently the object of their visit. In pantomime I thanked them profusely, but still they did not go! When I finally awoke to my obligation and presented each of them with a can of pork and beans they grinned broadly and, jabbering happily, departed almost at once.

The village is in charge of the Chief, who is elected by the natives each year. The present Chief, Michael Gorga Hodikoff, has held his position for the past several years, owing to his successful handling of the affairs of the village. The Chief is assisted by a Second Chief, Agefangel Prokopiof, the tallest man in the village. Both men are capable as well as industrious, and carry on in a most efficient manner.

Several times I had met the Chief's wife, Anastasia, a large, good-natured woman, and she had always smiled or waved without uttering a word, so I presumed she knew no English. One day she came out with Mike to where I was working and, walking up to me she surprised me by saying, "Ullo, my frien'."

Anastasia is one of the two or three women who can still make the famous Attu baskets which are known throughout the world to collectors and museums. This age-old craft is a very slow, tedious procedure and will soon become a lost art. It requires [illegible] and complete a basket.

The best of the basket makers is Maggie Prokopiof, who is familiarly known to the Coast Guard Service as "Mother of Attu." She does not know how old she is, but in her time she was acknowledged to be the best of the Aleutian dancers. Since dancing seems to have been at one time an important custom, it is surprising to find no musical instruments of any kind on the island except the phonograph. Unfortunately today the real old time dances are almost forgotten, the natives preferring modern dancing.

Maggie, whose name in Aleutian is Wassa, asked me once if I had any children. When I said, "No," she remarked sagely, "Umph, men no good, no good sometimes. Women okay alltime."

Chief Mike and Anastasia called on me one night, and in the course of the conversation I asked Mike if he had heard that King George V of England had died. "No," he said, "Fine ol' man." Then he went out and returned with a colored print of the Czar and his family to show me.

One-man radio station

Mike invited me to hear him broadcast, having been taught by the Coast Guard to use the radiophone. He is naturally proud of this accomplishment, always reporting the weather and anything else of importance that may have happened. Commencing at 8 o'clock each night, Mike starts with, " 'Ello, lo, lo! This KAJU calling KEAW, Umnak, Alaska." This he repeats three or four times. "If you hear this you let me know. This is KAJU, Mike speaking, if you listen you let me have answer okay eight bells." This he says so fast that the first time I heard it I wondered if he was talking Aleutian or English.

Another evening I was invited to Mike's house and found six people there for a tea party. Anastasia served the tea and ship biscuits. It is customary for the natives in their own homes to pour the tea into their saucers, pull the saucer to the edge of the table, and then bend the head down to the saucer to drink. They never did this, however, when they called on me. When smoking, the ashes are dropped on the floor and swept up. Of his wife Mike said, "She all time keep clean house, no do any work." That was the night he showed me the photos of his daughter who died as a young child. These photos showed the daughter ready for burial in her coffin.

No white men live on the island, and although an American has the trading privileges, he pays only a visit of a week or two to the village each year. The trader can supply the natives with all the staples and other necessities they need. When he is away, the Chief takes charge of the store. This store, in many ways, is an asset to the natives, but it also has some disadvantages, for the younger natives are no longer learning the crafts of the older people. Not many years ago the natives all made their own *mukluks* (waterproof skin boots), but today only a few make them, and not many pairs are seen in use. The *kamlaykas* (waterproof coats made from the intestines of the seal) are no longer made. It is easier for the inhabitants to purchase rubber hip boots and slickers, which are no more efficient, than to make them in the old way.

Thirty-five miles east of Attu is the island of Agattu. The natives go back and forth between the two islands in small dories with outboard motors. Why no lives have been lost on these trips is surprising but is probably due to the uncanny accuracy these people show in prognosticating the weather.

Livelihood

The trapping of the Aleutian blue fox during December and January is the only activity from which the Attuans derive any income. Agattu and Attu are trapped in alternate years. The trapping is a community proposition, the number of pelts being divided in proportion to the size of the families and their dependents. It is interesting to note that the church is considered as one unit of the community, and as such receives its pro rata share of the pelts.

Fish, which are caught with seine and gill nets, are also divided among the inhabitants. This community spirit, in the same manner, extends to the killing of sea lions. All sea lions killed are common property; the successful hunter, however, has the first choice of any part of the animal he desires.

Several times the Chief sent me some trout and on one occasion gave me some sea lion meat. He told me to boil the meat for an hour or two, but the smell when cooking nearly drove me from the building. Hot, the meat was very greasy and of a nauseating flavor; but when cold, with the grease skimmed off, it was quite palatable and tender. The cooked meat is almost black and flakes into long, thin strips like leather shoe laces.

The Russian Greek Orthodox church, situated at one end of the village, is an excellent building for such a small community. As there is no resident priest, the Chief leads the church services. Many interesting icons and colored religious pictures decorate the walls. On the doors leading to the sacristy are two old Russian oil paintings, and in the sacristy are many ancient religious books brought from Russia many years ago. In the belfry there is a decorated bronze bell, originally from Russia; but, for some unknown reason, this has been discarded for an American locomotive bell.

The majority of the natives now live in small frame houses, but a few still live in barabaras, the old type semi-subterranean earth houses. The barabaras that now remain in use have been modernized by board walls and floors, stove pipe chimneys, and windows.

These natives are a hard working people and are not often found idle. After the winter months have passed they proceed to the business of catching fish, often going to distant parts of the island and establishing temporary camps for this purpose. They travel many miles in their outboard dories to bring back driftwood for use as fuel in winter. Driftwood is not very plentiful and must be supplemented by coal from the store.

At certain seasons of the year they hunt seals, sea lions, birds, and eggs. Nothing is ever wasted; bent nails from packing cases are carefully saved; the skins, intestines, and stomachs of the sea mammals are used in various ways. Even the sea lion's whiskers are used for tooth picks, and salmon heads are strung up to dry and eventually used for kindling fires.

Years ago sea otters were hunted for their pelts, but as these animals are now protected by both America and Russia they are no longer being killed. The sea otter is still occasionally seen along the shores.

Sometimes the children tame young sea gulls and cormorants as pets, for there are no dogs and cats on the island. After reaching maturity these birds always forage for themselves, but return to their owner's home each evening.

No agricultural products are grown, for the natives state that the growing season is too short. However, vegetables are raised with some success on Bering Island, one of the Komandorskie Islands, 200 miles to the west, so it appears from this statement that the reason is a lack of ambition rather than fact.

Rare contacts with the world

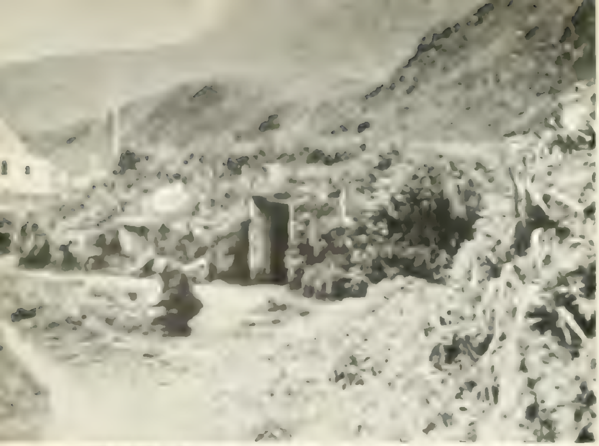
A ship of the United States Biological Survey or of the Bureau of Fisheries may occasionally make a call at the island. These visits and especially those of the Coast Guard Cutters are the high lights of the summer season. When a ship is sighted the Chief immediately raises the Stars and Stripes on the tall flag pole imported especially for this purpose. If the ship is a United States Coast Guard Cutter, Mike dresses in his best clothes—a blue serge business suit with shirt and tie to match—and goes aboard to report on the affairs of the village. He takes with him a list of the persons needing medical or dental aid. When the doctor and the dentist arrive in the village, the Chief sees that all patients are ready and waiting and makes himself definitely useful in many ways to the officers of the cutter.

The United States Coast Guard Service is the mother and the father of natives in the many remote, out-of-the-way villages of Alaska. On these men and their fine ships the natives depend for their meager contacts with the outside world, as well as for their medical and dental care. When a United States Coast Guard Cutter anchors in the bay for the night the whole village is invited aboard to see the movie show. They go out in their dories, all dressed up in their best for this occasion, and although not understanding the movie, they laugh uproariously in the most inappropriate places.

Generally speaking the health of the inhabitants is good, there being only two or three of the older men unable to do their share of the work. One bed-ridden old man, reported to be 104 years old, is conscientiously cared for by Chief Mike in his own home. Mike allows no liquor on the island. This, I think, is one of the reasons why Attu is the best of all the Aleutian villages.

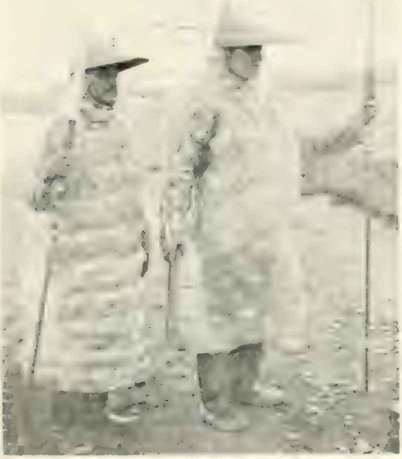
In the past few years the ways of the white man have made considerable inroads into their way of living, but they remain an unspoiled and likeable people.

Their greatest fear was of the Japanese. All the natives of Attu seemed to have this dread and they told a story of some of their men going out in two bidarkas (two-place kayaks) 25 years ago and never returning. Nothing was ever seen of the men or the bidarkas again, and although it would seem that there



▲ The traditional house on Attu is a half-underground *barabara* covered with sod, but most of the natives now live in small frame houses

Salmon are dried on racks on the island of Attu and are later stored for winter use



▲ Sea lion stomachs are cleaned and used as storage receptacles for the dried salmon

▲ Aleut hunters, dressed for the sea in raincoats made of seal intestines. This garment is serviceable but is no longer made, slickers being more easily procured

➤ Native boys of the Aleutian Islands. The zipper jacket, like other gadgets of civilization, has been eagerly accepted, but on far-off Attu the natives have remained an unspoiled and likeable people. Even before Pearl Harbor, their greatest fear was of the Japanese might be other explanations for their disappearance, every native on Attu is convinced that they were captured or killed by the Japs.

Farewells

One afternoon I was packing some archaeological material preparatory to my expected departure when I heard someone running, then stumble, and fall on the steps of the building. "An accident," I thought. I found an old native getting up from the steps. He was badly out of breath and only gasped, "Uk—uk!" At first I did not understand, but then he pointed seaward and there was the "Shoshone" just coming in through the entrance of the bay to pick me up after my several weeks on the island.

The "Shoshone" stayed overnight in the harbor and the usual movie show was given for the Attuans. After the show I said a lingering farewell to my Aleut friends on deck, last minute gifts were exchanged, and then they went back to the village—back to the routine of their placid existence.

We left at daybreak for Kiska, and I did not see my friends of Attu again until the following summer. I received several letters from Mike after I returned in 1937, but it has been a long time since the last one came.

When I read of the Jap invasion of Attu I wondered, What did Mike do? Did he run up the American flag when he sighted their ships? Were the natives alone on the island? Did Mike dash to his radio and perhaps, even faster than usual, tell Umnak what was happening? —Or were they too terror-stricken to do anything but hide in the hills? Most of all, I should like to know what has happened to my friends there,—to Mike and Anastasia, to Agefangel, Maggie "Rock of Ages," and the rest. I hope that they are safe but I'm sure that they are not as placid and contented as they were when I knew them.

▼ **FLOCKS of sheep being driven to the top of a hill by high-booted native "cowboys" on Umnak Island in the Aleutian chain**

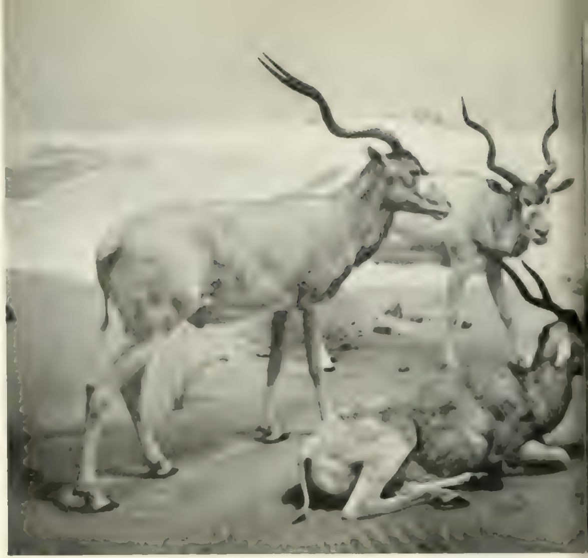
▼ **PILLAR ROCK is a beacon to Attu's only safe anchorage**

Photos by Alan G. May

ALEUTIAN blue foxes *(below)* are comparatively tame on Agattu, often follow one for miles, like a dog

MAGGIE or "Rock of Ages," a well-known character of Attu and one of the best basket makers ▼

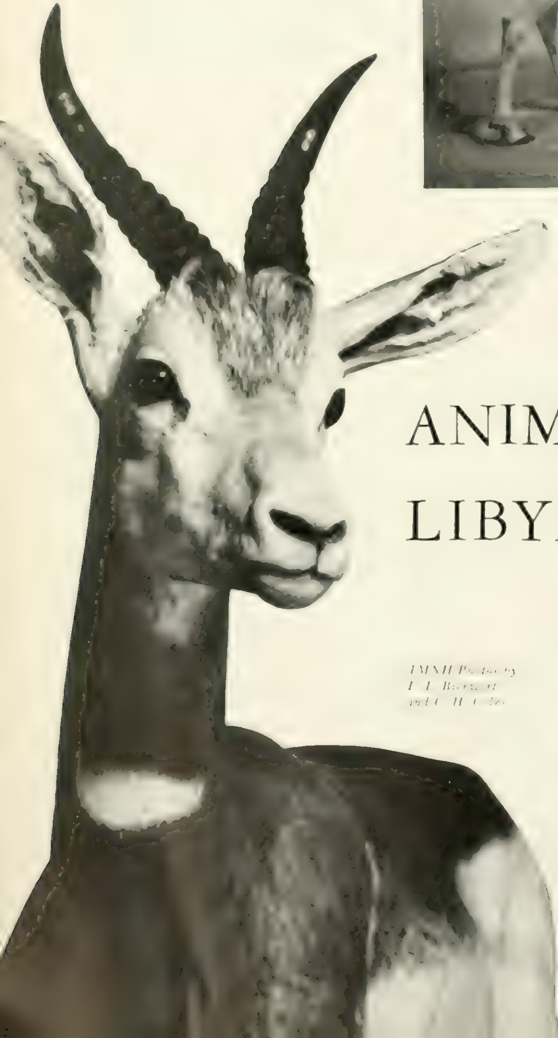
This exhibit, which is one of the latest additions to Akeley African Hall, is the exact replica of a typical scene in the Libyan Desert and shows some of the animals that are specially adapted for life in the arid, sandy wastes. Both the addax (*left*) and the scimitar oryx (*right background*) have wide, spreading hoofs, effective for traveling over the yielding sand. For food all these animals depend on the sparse vegetation of the sand dunes, migrating from place to place in search of pasturage



▲ The spirally twisted horns of the addax (*Addax nasomaculata*) have been known to reach a length of 39½ inches

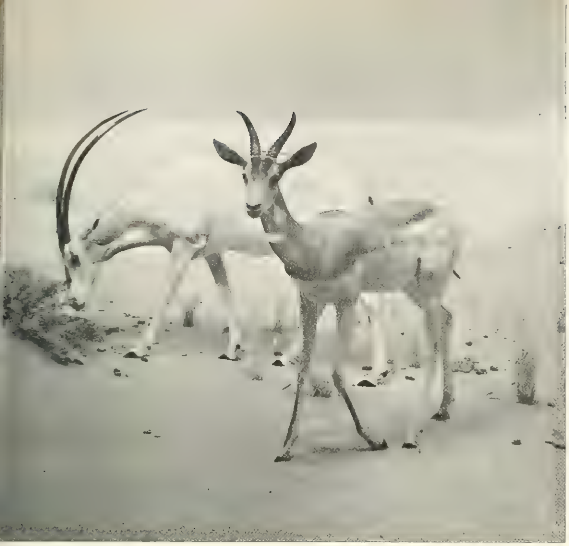
ANIMALS OF THE LIBYAN DESERT

A group portraying the landscape and wild life south of the Egyptian war front, on display in the American Museum



AMNH Photos by T. L. Bierwert and C. H. Coles

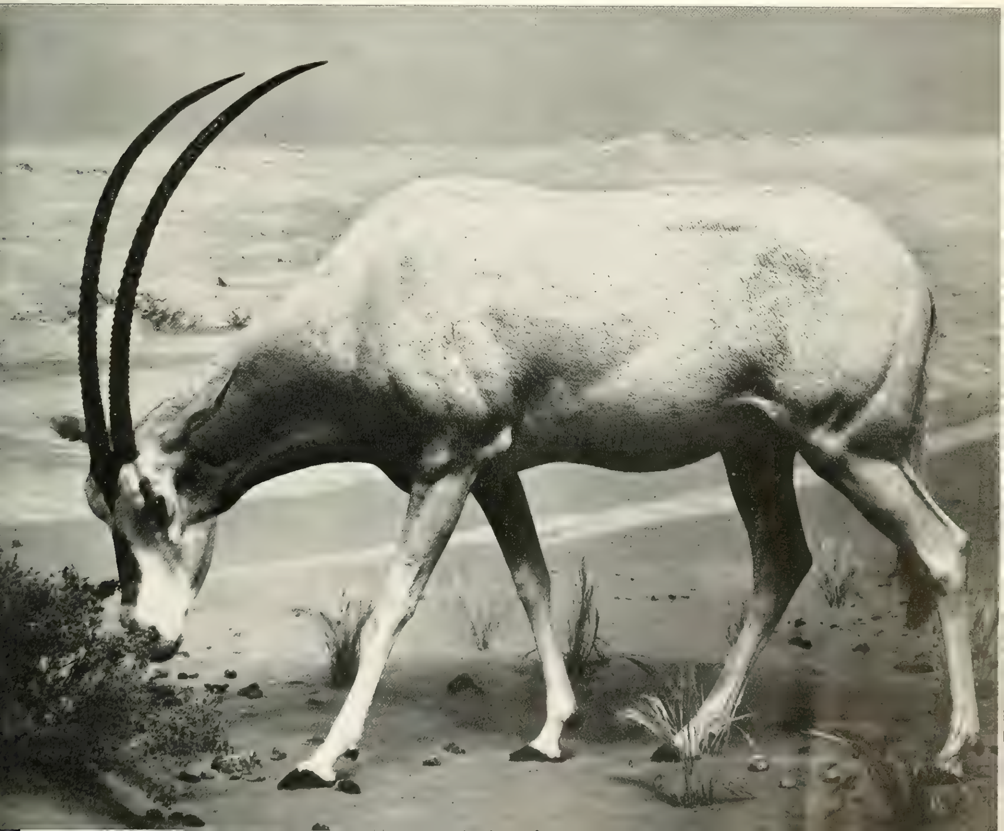
The graceful addra (*Gazella dama ruficollis*) is one of the swiftest of the gazelles. Its pale color and reddish marking blend well with the desert landscape, to which it is restricted. When browsing among the shoots of an occasional thorn tree, it often balances itself straight upright on its hind feet. It is one of the largest of the African gazelles, but its tail is only six inches long



▼ The scimitar oryx *(Aegoryx agazel)* derives its name from its long, curving horns, and it is also known as the white oryx. It is pale in color and is probably the animal frequently seen as decoration on old bas reliefs and frescoes of ancient Egypt. Its present range is limited to a few sections of the Libyan Desert.

Animals for this group were secured and presented by W. D. Campbell, who described the expedition for securing them in the October, 1938, issue of Natural History Magazine

The group was designed and executed under the direction of James L. Clark, with Robert H. Rockwell mounting the animals and James Perry Wilson painting the background. The foreground and accessories to complete this true-to-life exhibit were executed under the direction of Albert E. Butler



DESIGN *for* *Swimming*

By G. Miles Conrad

Illustrated by the author

Showing that many of man's "inventions" were discovered by fishes ages ago and that these masters of streamlining bow to the submarine only in the matter of destructiveness

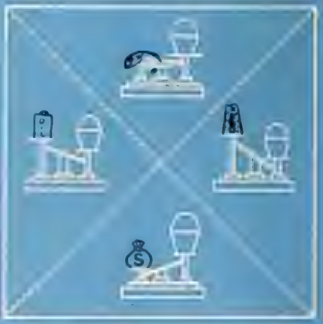
"Like a fish out of water" is proverbial and its converse is even more true. A fish in water is the epitome of perfect adaptation to environment.

Buoyancy, power, speed, maneuverability — all these and more are the problems that have confronted free-swimming aquatic life in its attempt to overcome space. Of all the classes of animals none have coped with these problems as completely and effectively as the fishes.

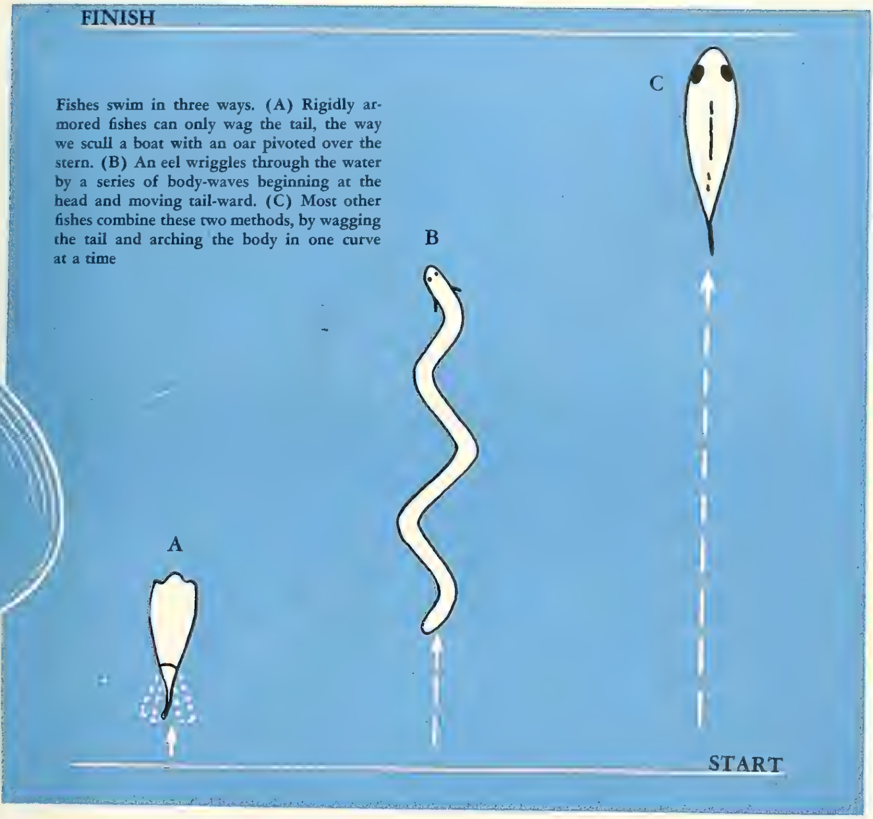
The specific gravity of organic matter (its weight relative to water) is about 1.05. This means that unless the fish devises some means of neutralizing his slightly greater weight he will sink to the bottom. For inshore fishes and most fresh-water fishes this would make little difference, but for the many open-sea fishes sinking would be a calamity. In the great depths of the oceans, pressures as high as seven tons per square inch are encountered, and at the average bottom depth of all the oceans the pressure is almost three tons. The rapid sinking of an object weighing more than water would mean that the fish would be crushed to death long before its internal pressure equalized that of the surrounding water. Even the long-distance soaring birds come to roost easily, but the fishes of the open sea must keep going, must keep combating adverse forces. They wage unceasing battle with the force of gravity.

Fishes and other water-living organisms — even plants — have developed numerous methods for creating and maintaining buoyancy. One dodge that is common among invertebrates is to absorb enough of the surrounding water to reduce their specific gravity and make it approach that of water. Thus the jellyfish keeps afloat with but little hindrance from gravity. For the more intricately organized fishes the absorption of water is not often resorted to, although some fishes lighten themselves by storing away fluids that weigh even less than water.

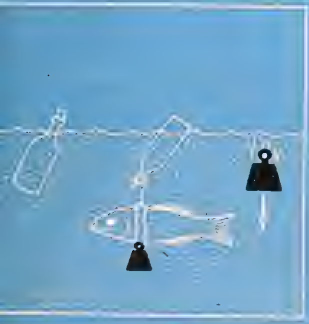
This is exactly what the sharks and many bony fishes have done with eminent success. While flotation is not the primary function of the liver, the fats and oils stored there serve this purpose admirably. Cod, halibut liver oil, and "oleum percomorphum" are all stand-bys of the medicine chest. Oil is poured on troubled waters to quell the waves and is effective largely because it is lighter than water and forms a floating blanket.



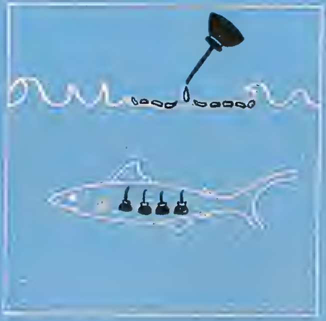
Animal matter is usually heavier than water. If an object weighs more than an equal volume of water, it will sink, even if it is a fish



Fishes swim in three ways. (A) Rigidly armored fishes can only wag the tail, the way we scull a boat with an oar pivoted over the stern. (B) An eel wriggles through the water by a series of body-waves beginning at the head and moving tail-ward. (C) Most other fishes combine these two methods, by wagging the tail and arching the body in one curve at a time



Without buoyancy, a fish would sink to he bottom of the ocean and be crushed to leath by the terrific pressure—almost three ons per square inch at average depth



Oil calms the troubled waves because it is lighter than water and blankets the surface. In a fish's tissues it lightens the body and helps prevent sinking [illegible] its buoyancy and may alter its density to meet the [illegible] to dive and then blows it out with com- [illegible] bladder are bunched masses of capillaries which, it is said, secrete oxygen, nitrogen, and carbon dioxide. Another structure, also in the bladder wall, absorbs [illegible] specific gravity of the fish but it also serves to combat [illegible]

Some fishes, for example the rays, which lack a swim bladder, tend to have a flattened belly. This slows their tendency to sink just as a plate laid flat on the water sinks slowly by side-to-side slipping. [illegible] fish by giving it buoyancy.

[illegible] might think that one body shape would be most efficient for all fishes. If by efficiency we mean optimum speed in a straight line for a certain size of body, we would be correct. However, just as other animals have developed different weapons of defense and offense, so have the fishes. Different methods for killing and swallowing their prey often require modifications of the body-form. Various methods of swimming are of special value to the fish either in the pursuit of food, in escape from enemies seeking him for food, or merely for convenience and minimum waste of energy in his particular habitat.

Dr. C. M. Breder, Director of the New York Aquarium, made an exhaustive study several years ago of the methods by which fishes progress through the water. His work showed that there were three basic types of swimming in fishes.

The first of these has been called *anguilliform*, or eel-like. This method of progression is confined to very long-bodied, snaky fishes such as the eels themselves and the gymnotids, or electric eels, of South America. The second type was called *ostraciiform* after the group name of the rigid boxfishes, or Ostraciidae. The third type of locomotion he called *carangiform*, or in the manner of the pompano or jack. This is the way most fishes swim.

[illegible] series of undulations which start behind the head and [illegible] to the rear they encounter, first on one side and then on the other, the resistance of the water. This results in a series of shoves which move the animal forward. The eel goes through the water somewhat in the way a screw goes into a piece of wood except that the eel's motion is flattened out instead of being an actual spiral. But the undulations of his body have to move faster than the resulting straight-forward movement. In other words a great deal more energy is expended by the eel in gaining a fair speed than by the average fish.

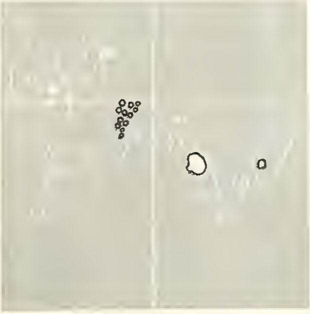
The boxfish and a few of his relatives are encased in an armor that prevents any sinuosity of movement except in the tail. Thus in Breder's ostraciiform movement we are presented with a very close analogy to the sculling of a boat. All of us are familiar with the way in which a rowboat may be propelled forward by one oar pivoted over the stern and pushed from side-to-side. This is exactly what the boxfish does, and it is largely by his tail-wagging, supplemented by his vigorous pectoral paddles, that he moves about.

The pompano method of locomotion, by which the greatest number of familiar fishes swim, is a combination of both the other basic types, for it makes use of the side-to-side motion of the tail plus a certain amount of sinuosity not permitted in the armored fish. Instead of throwing the body into a series of opposing arcs, as the eel does, most fishes arch their bodies into only one curve at a time.

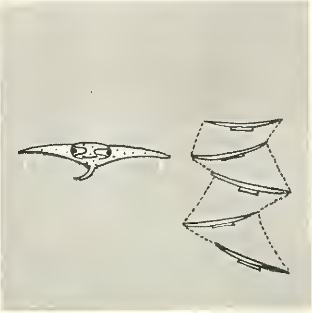
That these movements of the body as a whole are basic in swimming would be a surprise to some of us, accustomed as we are to the swimming of most mammals, in which the extremities act as more or less efficient paddles. Many of us are apt to think that the fins of the fish are the paddles by which the body is moved. Although there are a number of special cases in which the fins of fishes do serve as secondary, or even primary, locomotor organs, they are usually used merely as rudders and stabilizers.

The downward pull of gravity and the action of fins designed to hinder its effect should result in a long, easy-sloping glide. Much of the locomotion of fishes might be described as a series of these glides accompanied by periodic upward recoveries. This is also the way in which an air-glider progresses.

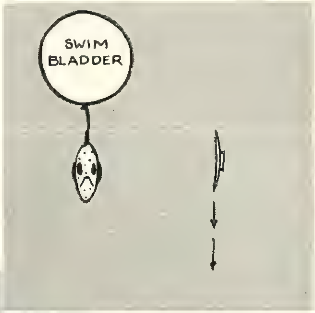
Whence comes the power which is translated into these swimming movements? The very basic unit of the fish's engines is the striped muscle fiber, a small thread-like structure. Numbers of these are bunched together in **W**-shaped units, called myomeres. The myomeres fit one into another along both flanks of



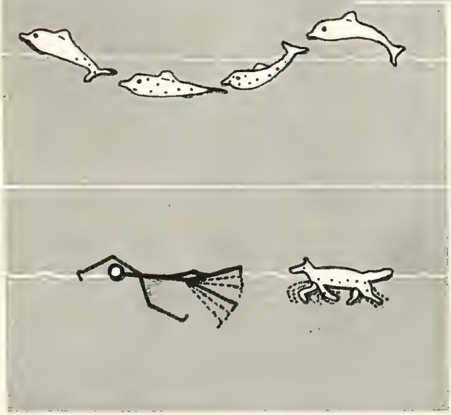
A submarine takes in water to dive, blows it out again to rise. A fish regulates the gas content of its swim bladder for the same purpose



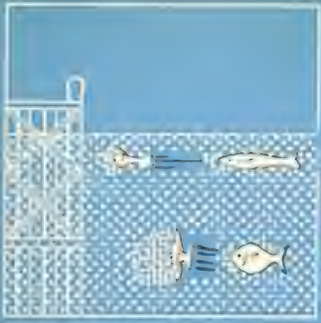
Many fishes lacking a swim bladder are flat like a plate, which sinks slowly by slipping from side to side. The shape helps the fish to stay up with less effort (*above, right*)

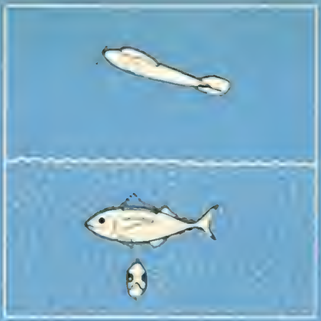


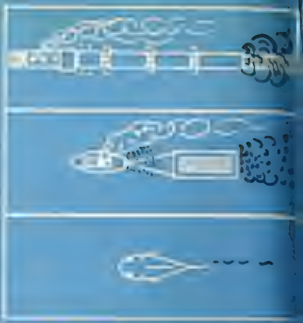
A plate on edge sinks rapidly, and so would a narrow fish except for the swim bladder in its body giving it buoyancy



Many suppose that porpoises and fishes work their fins as paddles just because people and four-legged animals swim that way. Fins are chiefly rudders and stabilizers (*left*)


Fishes living in crowded waters, as among coral formations, must be stop-and-go swimmers. These are often broad, so that they can halt abruptly by turning the body sideways


Like a plane that retracts its landing gear in flight, powerful speed swimmers are sometimes equipped to fold their foreward fins into slots, as shown by the dotted lines. The tuna thus becomes a living "teardrop"


Behind a train, whirling dust reveals i efficient streamlining. Similarly, whirlpool behind a square-sterned barge indicat wasted power. Fishes have avoided thi fault without exception

the body, and the nerves affecting them are arranged in such a way that the contraction of one is followed immediately by that of its neighbor, and so on. Secondly, after this wave is initiated on one side of the body a similar wave starts on the opposite side. The result of these waves in an extremely long-bodied fish is eel-like movement; in a shorter one, pompano-like movement; and in a fish whose action is confined to the back part of the tail, the sculling action of the boxfish.

In this age of streamlined airplanes, railroad trains, and automobiles we are apt to think of "streamline" as design which permits the utmost in speed. However, streamlining also implies efficiency of performance for the particular task, and low fuel consumption. Thus the best streamlined design for an airplane, which must lift itself into the air, could not be readily adaptable to a train whose superstructure moves through the air while its driving mechanism must contact the rails. The various fishes have different jobs of living to perform. Some are fast swimmers in the wide open ocean and must catch their food by running it down, others live among crowded coral tenements near shore and must be "stop-and-go" swimmers to avoid traffic jams and collisions. Still others are bottom-dwellers, nestling close to or groveling into the bottom.

Speed swimmers

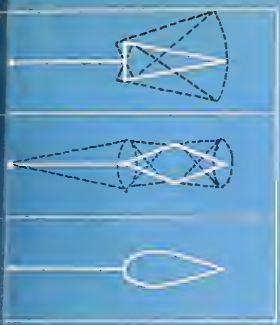
The fast swimmers all make use of pompano-like movements, but not all of them are of the same shape. Many swimmers in the open ocean—like mackerels, bonitos, and tunas—have the characteristic spindle shape, with the area of greatest cross section toward the head end of the body. They are invariably more or less oval in cross section and have a longish body which can deliver powerful side-to-side sweeps. At high speeds all the fins are tucked away close to the body, except for a few rigid stabilizers that prevent the fish from rolling with the tremendous power of the body-sweeps.

On the other hand, among the tortuous and narrow canyons of corals and pilings the fishes are often diamond-shaped in side view. Such a deep body when turned suddenly will very effectively brake the forward momentum developed at even high speeds. Thus the inhabitants of crowded quarters can dart and turn and wheel about with great ease, escaping collision with one another. In the main their food is stationary, and so they have no need for long, fast swims in pursuit of fleet prey.

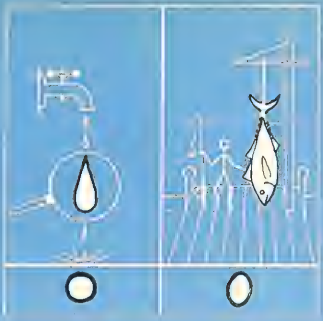
Lurking among the crevices and tunnels are found the morays, unusually lazy eels that are often reluctant to forsake their hideaways even to grab a choice morsel. When forced to desert their dens they of course swim in eel-like fashion.

Perhaps the culmination in speed perfection is the tuna. When the tuna starts a speed run, it folds the prominent fin on its back like a fan into a deep, narrow groove completely out of the way, where it is covered over with two thin flaps of skin. The pectorals must also be gotten out of the way, and along the flanks of the body are two depressions of the proper shape and depth to accommodate them. When the tuna has tucked away all its superfluous bumps, it is a living "teardrop."

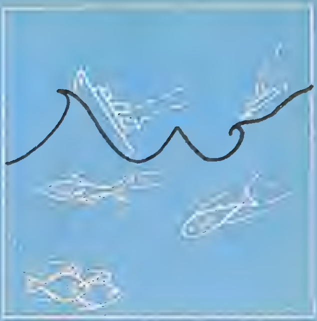
Several years ago, at Wedgeport, Nova Scotia, I had the good fortune to go out on a commercial tuna-fishing boat. In these waters the tuna are harpooned from rather small gasoline-driven cruisers. After an hour's maneuvering we luckily spied a tuna, and our harpooner promptly stuck it. Now in the swordfishery, farther north, when a swordfish is harpooned a keg is thrown overboard to which the line is attached, and the fish is allowed to tow the keg hither and yon until thoroughly tired. But when we tied into our tuna the line was fastened to a dory! The dory was thrown overboard. Ours was a rather slow boat making perhaps seven or eight miles an hour, but when we tried to catch up with the dory, I was astonished to find it slowly pulling away from us. The tuna was towing a goodly length of line and a dory at about ten miles an hour. The rope was slanting to great depth. In 30 minutes or so the fish had sufficiently tired so that we were able to approach and capture it —but not without a fight! Other fishes have such



uare bow is obviously inefficient and urages wobbling. Nor is a sharply ted bow much better. A curved bow st, with greatest cross section forward e middle



A drop of water from a faucet assumes the ideal shape. Its rounded front and tapering tail are commonly regarded as the perfect embodiment of streamlining. Tunas are similar, but oval in cross section



Because a boat travels through both air and water, it cannot be compared with a fish. The naval architect, unlike a fish, must fashion his ship so its bow will rise with the wave

strength, for example the manta, but it is doubtful if they have the speed.

Work has been done in recent years on the principles of engineering involved in the streamlining of a fish. It must be pointed out first that regardless of the density of the medium through which an object must pass, the basic rules of streamlining remain the same. Thus a form which moves efficiently through air will move equally efficiently through water, or even through oil for that matter. Why then are submarines so slow when compared with airplanes? There are several reasons but the main one is the obvious one that the denser medium offers more resistance.

Eddy currents

Therefore knowing that the dynamic properties of gases and liquids follow the same laws, we may examine the efficiency of some of man's efforts compared with those of the fishes. If you have ever stood on the rear platform of a train chatting with the brakeman you must have noticed the great swirl of dirt and paper which follows like a tail. The air vortices and eddies which are creating this disturbance are caused by air which has been displaced by the train in moving forward, rushing to fill the partial vacuum at the rear platform. For the same reason a boat with a square stern leaves a wake full of whirlpools and eddies, which tend to hold the boat back. This is one faulty element of design which fishes have without exception avoided.

At first thought it seems that a sharply pointed front end is all that is necessary for an object to cleave more easily through the air or water. But this is not the case. A sharp point, strange as it may seem, is not as efficient as a dull one. And besides this, there is the crucial question of the curve of the sides of the body—especially the location of its greatest cross section or bulge.

Common sense, backed by experimental trials, tells us that an object which presents a flat surface to the direction in which it is moving is bound to be inefficient. The towing of a scow is a slow and laborious job, even if it carries no great load. Furthermore, experiment shows that if a perfect spindle shape has its greatest cross section at the middle, it is not much more efficient than the scow-shaped object. Somewhere between these two is the best shape for a "high-speed" streamline. That is, the greatest cross section of the body must be somewhere between the middle and the front end.

The cross section of the wing of an airplane is frequently used as an example of streamline, but this is not too good an example, for one of the functions of the wing is to lift the plane. A better analogy may be found in the fuselage or body. Best example of all, however, is the familiar teardrop shape—the shape of a drop of water dripping from the kitchen faucet. In order to respond as quickly and as efficiently as possible to the attraction of gravity the drop assumes what is commonly considered to be the perfect embodiment of the streamline. We see that it has a rather blunt front end—not pointed, not flat—with the greatest cross section well forward, and with a tail which tapers sharply to a point; a description, incidentally, which cannot be improved upon for the general body-form of the tuna. However, the fish and the teardrop differ in the shapes of their cross sections. The drop is circular, and the fish oval.

Fishes differ from surface craft

The greatest difficulty in comparing man-made objects, such as submarines or airplanes, with fishes is that fish are flexible. In fact their very movement depends, as we have seen, upon the sinuosity of their bodies. It is only when the fish is coasting or gliding along under momentum attained by violent muscular effort that we can compare it with a submarine. If we try to compare a fish with a surface boat we run up against the difficulty that the boat travels simultaneously through water and air, which have markedly different densities. For example, the naval architect is much concerned with the "lift" of a vessel, or the ability of a ship to raise its bow with the wave so it will not be buried in the

[illegible]

[illegible]

Because the fish, [illegible] he must [illegible] keel and prevent tipping over. The tail fin aids him in this, with its upper and lower lobes, which are quite rigid [illegible] there are a number of dorsal and anal finlets which are nondepressible and one or more fleshy tabs jutting out at the narrowest part of the trunk region. These act as stabilizers somewhat as do the feathers on an arrow, or the bilge keels of a ship.

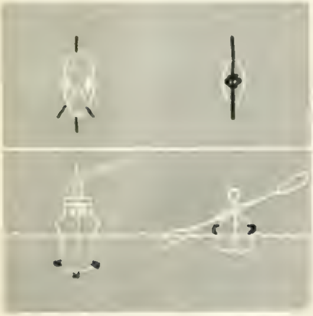
The distance from the [illegible] to the plane of greatest cross-section is called the "entering-angle." The remaining distance from this plane to the hind end of the body is called the "run." The relative lengths of these [illegible] vary from species to species in keeping with [illegible] habits. The high-speed fishes have a relatively short entering-angle and a [illegible] long run. [illegible] quick turning darters are apt to have these two measurements more nearly equal.

One of the drags on a body moving through a gaseous or liquid medium is caused by "skin friction," which is probably a surface tension phenomenon. In an effort to cut down this skin friction the hulls of boats have been kept as smooth as possible, and at one time it was popular to grease the hull to make it slip through the water smoothly. A vessel has actually been designed whereby this skin friction is cut to a minimum by jets of water released along the flanks at about the plane of greatest cross section. These jets form a sort of lubricating coat over which the water already displaced by the entering-angle can flow quickly and smoothly.

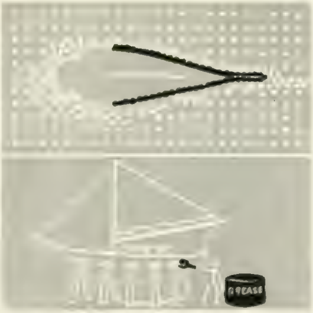
Having learned that such a device actually increased the efficiency of movement, it was easy to turn to the fishes and see that this was exactly what they had been doing for over 100 million years. Water taken in at the mouth for purposes of breathing is expelled through the gill slits, which are usually placed near the plane of greatest cross section—[illegible] position for such jets. The flanks of the fish are thus coated not only with the usual mucous but also with a very thin glaze of water which remains relatively stationary while the water [illegible] to fill the potential void behind the fish. If the run tapers sharply, the displaced water is returned with the least possible turbulence. So important is the squeezing effect of the returning water as it closes in on the run that it tends to push the fish forward. This action has been described by some as the same effect by which an orange seed may be shot out from between thumb and forefinger.

Even some fishes that lead sedentary lives have to be streamlined, in order to keep from being swept away in a rapid stream. The same principles of streamlining apply, of course, whether it is the fish or the water that is moving. Thus brook trout can face up a fast-flowing stream and maintain their relative position merely by lazy, easy back-paddling of their fins. So streamlined are they that the stream flows around them with little pushing effect. There are others living in swift flowing rivers which characteristically hug the bottom. In such forms the upper surface usually presents an efficiently streamlined shape to the moving stream.

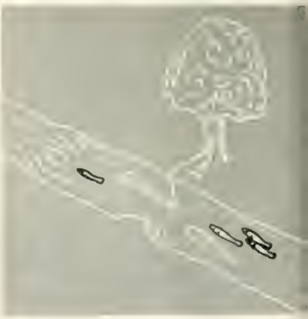
There remains much more experimental work to be done in the study of fish streamlining. So far, wind-tunnel and towing-tank tests have been confined to rigid bodies, not the flexible dynamic machine that is a fish—a machine that finds its fuel as it travels and bows before the submarine only in the matter of destructiveness.



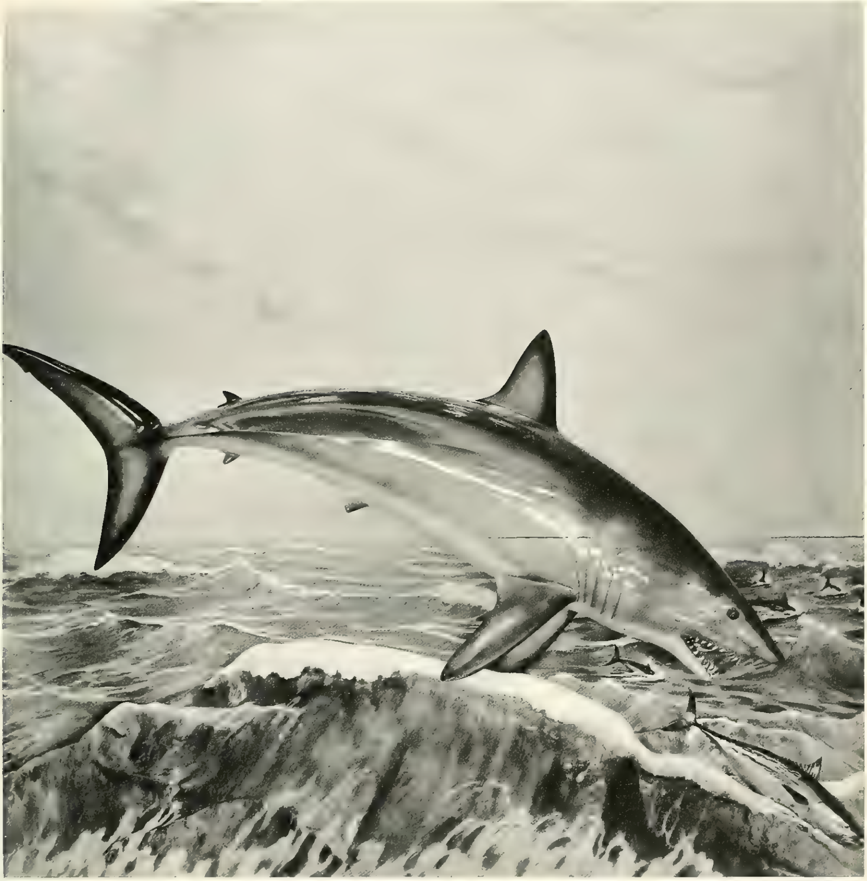
A fish propelling itself powerfully forward could not keep on steady keel without fins. Bilge keels on a ship and "blisters" on a sponson canoe serve the same purpose



It was once popular to grease the hull of a ship to make it faster. Fish have been "lubricating" their sides with a stream of water from the gills for 100 million years



Even if not great travelers, fishes in swift streams must swim fast to stay where they are. To meet their varying conditions of life, fishes have achieved almost perfect body design



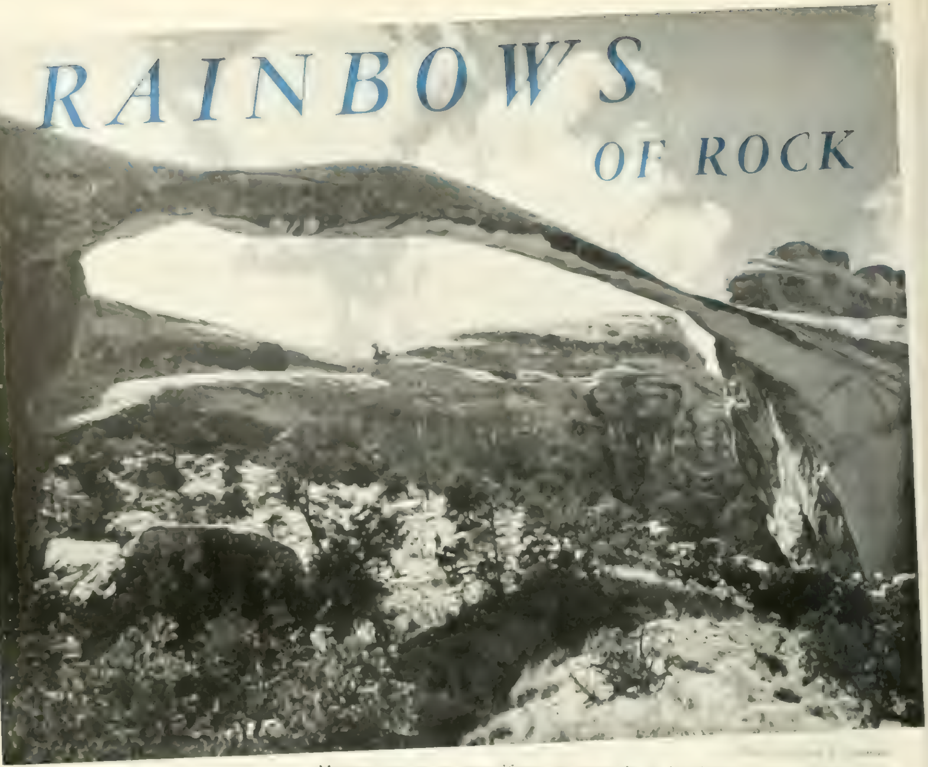
AMNH photo by T. L. Bierwert

A new exhibit just completed at the American Museum

Mako

Spectacular in its ability to leap as high as the masthead of a fishing boat, or approximately 12 feet into the air, the Mako shark is described as the most difficult fish to boat by Michael Lerner, who caught the 602-pound specimen from which the exhibit was modelled. Here it is shown in the normal pursuit of its food, ready to clamp its sharp-toothed jaws upon an unwary albacore. In the background, beneath the yellow sky of early morning, other albacores break the surface. The Mako has been known to wreck deck and cabin of a fishing launch by its terrific lunges. This specimen was boated off the Bahamas after a sixteen-minute battle. The group was executed by the Museum's Department of Arts and Preparations under the direction of Dr. James L. Clark and Mr. Albert E. Butler.

RAINBOWS OF ROCK



MARVELLING at so magnificent an example as Landscape Arch *(above)*, one may well wonder why Nature carved so many of these spectacular bridges within a radius of a few hundred miles. The curious purpose they served is a key to the interpretation of our arid Southwestern landscape. This span, in eastern Utah, is 291 feet long

By H. E. VOKES

[illegible]

ANY traveler who has seen the great gorge of the Grand Canyon, the snake-like course of the San Juan river through the "Goosenecks," the tall spires of Shiprock and Monument Valley, or the brilliant colors of the Painted Desert and Bryce Canyon will surely agree that Nature seems to have considered this desert region a "gallery" for her sculptural masterpieces.

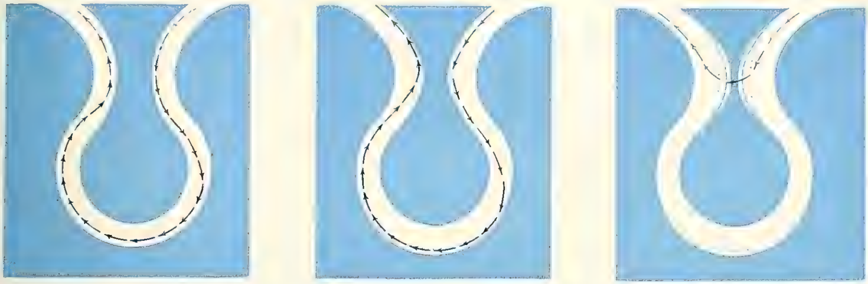
Each of these scenic wonders is a classic example of its kind. But with typical perverseness Nature has hidden the most unusual of these wonders in the most inaccessible parts of this inaccessible region. Here on the great platform of northern Arizona and southern Utah—a platform so intricately dissected by narrow, steep-walled box canyons that travel across its surface is almost impossible—she has carved the greatest natural bridges in the world. The security and isolation of these giant rainbows of stone might almost be interpreted to mean that Nature has deliberately placed them where only those willing to pay the price of hard and arduous travel may be permitted to gaze upon her ultimate masterpieces of beauty.

Nature and Man both build bridges. When Man does so, he is concerned first of all with the utility of his work. His bridges are built upon the most traveled highways of the world. Beauty is of secondary importance. Nature's greatest bridges span streams that one could almost leap across; and to us, beauty is pre-eminent, utility seems non-existent. But from Nature's point of view, utility is well served by the gap under the bridge, for through it the stream is enabled to flow by a shorter route to its ultimate destination. Thus, Man is particularly interested in the upper, traveled surface of his bridges; Nature, in the open span beneath them.

How Nature carved them

The story of the formation of these natural bridges is one that is easily deciphered and understood. The

HOW A NATURAL BRIDGE IS CARVED



▲ A WINDING RIVER in a canyon cuts mostly along the outside curves

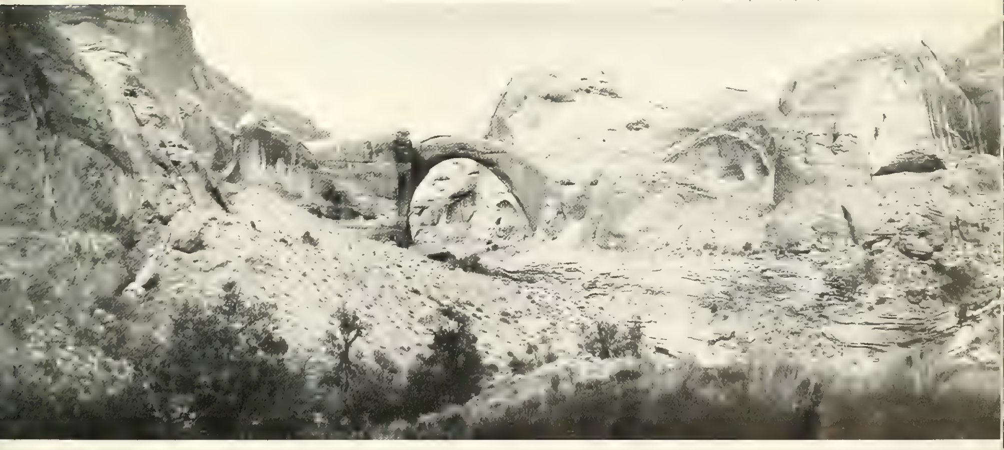
▲ IT CUTS faster if softer rock is met. Note that the loops nearly touch

▲ BREAKING THROUGH, it flows under a rock bridge, abandoning the loop

Goosenecks of the San Juan, as explained in our story in the May issue of NATURAL HISTORY, owe their development to the fact that a broad, flat plain, across which the ancient San Juan River flowed in a winding course, was slowly uplifted, and that the river incised its crooked course as the land rose. Now it so happens that the ancient San Juan was not the only river crossing this great plain at that time. Among the others was one which today is known as White River, located about 30 miles north of the Goosenecks; and another one was located about 70 miles almost due west of them. Both of these streams, meandering broadly, cut their crooked courses deep into the plain as it was uplifted to form a broad plateau. Both found themselves, along part of their course, cutting their canyon through a heavy sand-

▼ PROBABLY the most famous formation of its kind in the world, Rainbow Bridge is nevertheless difficult to visit, requiring a round-trip of about 30 miles on foot or horseback from Rainbow Lodge, near the Utah-Arizona border. The bridge is higher than the Capitol in Washington. To the right are two partly formed arches, where the river tried to cut through and gave up

United States Geological Survey photograph by La Rue



[illegible] White River [illegible] a narrow rock isthmus intervening (see diagram).

Now it is the rule that the current of winding streams always flows along the outer edge of the curves, and therefore they cut their banks on that side. This rule operated along White River, but when the stream was flowing through the heavy sandstone beds, it could not do a very appreciable amount of cutting along the massive walls. However, when it had cut down to the softer layers underneath, the walls began to retreat as the current gouged them out. The heavy sandstones were undercut from both sides. Finally the stream broke through and [illegible] channel through the [illegible] was left bridged by the massive sandstone above. The peninsula of rock had in effect become an island, while the remnants of the isthmus remained as a bridge connecting the island to the "mainland."

How to estimate the age

Once the bridge is formed and the stream begins to flow under it, its subsequent story is clearly foretold. In times of flood the swollen waters not only deepen the river channel, they tear away at the buttresses of the bridge, tending to widen the span. This causes massive blocks of sandstone to "spall" off from the under side of the arch. The bridge thus becomes longer and higher above the river. But this causes the span to become more and more slender, and at some future date it will collapse entirely. Then the river will flow past the rock "island" between the remnants of the buttresses, which will serve as the sole monuments to the glory of the past.

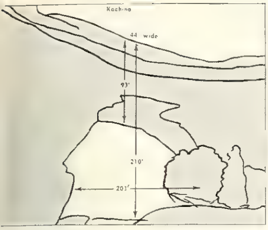
This history of the bridge is not hypothetical. In the drainage system of the White River there are today three great bridges that admirably illustrate the life history of the bridge itself, and in some trench-like cutoffs the observing traveler can distinguish the worn buttresses of fallen and forgotten monarchs.

But while the bridges are thus, in terms of geological time, only ephemeral phenomena in terms of human existence they probably achieve hoary antiquity. On this, however, we cannot speak with any certainty, for spectacular though they be, they are among the most recently discovered scenic features of our country. While it is very possible that they may have been observed by trappers and prospectors [illegible] the first white man to report these [illegible] named Cass Hite, who with an Indian guide, "Piute Indian Joe," spent several [illegible] 1883 prospecting in the upper canyons of the White River area. His stories of the bridges he saw there were so picturesque that he was soon followed by a number of pioneer settlers. But it was 20 years later before the outside world became aware of their existence. In 1903 Horace Long, a mining engineer, visited the region under the guidance of James Scorup, of Bluff, Utah. His illustrations and descriptions furnished the basis for an article in the *National Geographic Magazine* by W. W. Dyer, published in September 1904, which attracted so much attention that, on April 16, 1908, President Theodore Roosevelt set the region aside as the Natural Bridges National Monument.

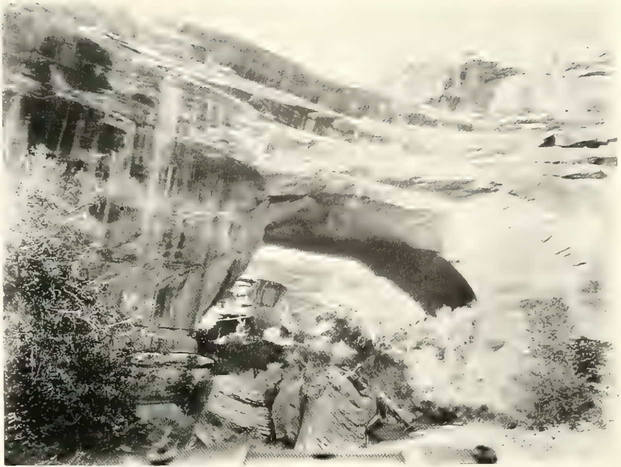
The three spans which grace the area illustrate remarkably well the history of the typical bridge. The youngest and most massive of the three was called The Senator by Hite, and Carolyn (after the mother of James Scorup) by Long and Dyer. In the Presidential proclamation, however, the more appropriate Indian name, *Kachina*, was applied to it. *Kachina* is the guardian spirit of the Hopi Indians, and the symbol of the sacred dancers of that tribe was found carved upon one of the buttresses of this bridge. The youth of this arch is well shown by its massive thickness.

The largest of the three bridges is of middle age as compared with the others. Cass Hite called it President Bridge; Long and Dyer termed it Augusta after Long's wife; by Presidential proclamation it became *Sipapu* Bridge. The modern Indians of northern Arizona and southern Utah believe that they came into the world from a lower region through an opening which the Hopis call *Sipapu*, the door of life. After death they return through the same hole to the nether region, where they spend a period of purification before ascending to the sky to become rain-gods. The name seems particularly appropriate for the great sandstone gateway of White River Canyon.

The oldest of the three is also the smallest. It stands in Armstrong Canyon, a tributary of White. A slender, graceful strip of rock, it is perhaps the most beautiful of the three. In addition to its greater weight of years, it has stood up under four different names. Hite dubbed it Congressman Bridge; Long and Dyer unimaginatively termed it simply Little Bridge, but this name soon gave way to Edwin when it was so christened by an expedition sent out by the Salt Lake Commercial Club in 1905. President

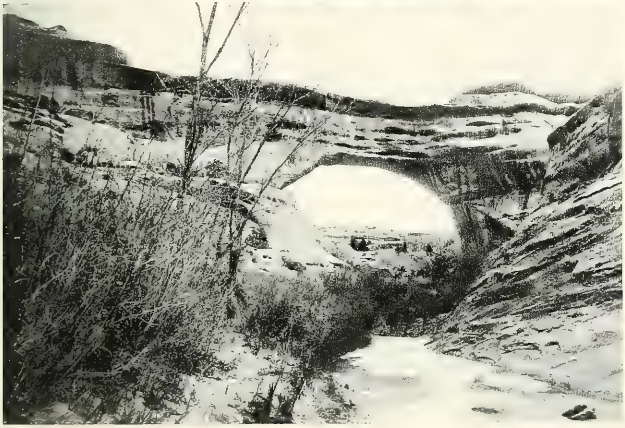

Kachina
44 wide
93'
210'
203'

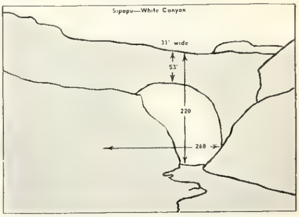
➤ THE THREE SPANS on this page illustrate well the history of the typical natural bridge. Kachina, the youngest, is the most massive, having suffered less from the ravages of time



United States Geological Survey photograph by W. T. Lee

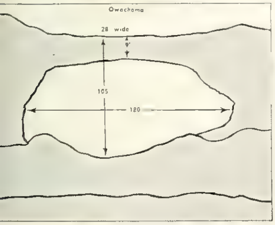
United States Geological Survey photograph by W. H. Hopkins



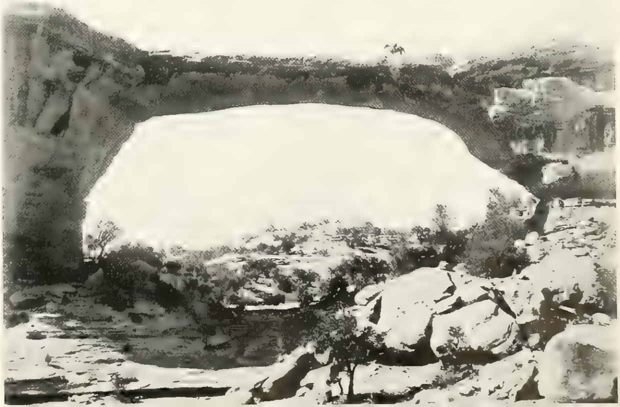

Sipapu—White Canyon
31' wide
53'
220
268

◀ THROUGH SIPAPU flows a river which formerly had to make a wide detour around the long buttress of rock it now pierces. More rock has been removed here, so the bridge can be classed as middle-aged. Note the small figures on top

United States Geological Survey photograph by W. T. Lee


Owachoma
28 wide
9'
105
180

➤ THE OLDEST of the three is Owachomo, whose slender span speaks for its antiquity. In this region numerous remnants of bridges are also found, where the span, in extreme age, has collapsed



[illegible]

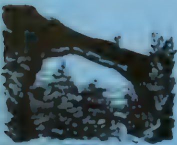
[illegible]

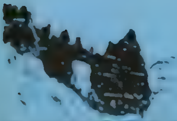
Other bridges are not rare in the great Southwest. The incomparable *Nonnezoshie* (Rainbow) Bridge [illegible]

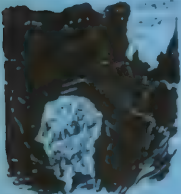
[illegible] of Bridge Creek, it would easily span the dome of the National Capitol. The arch is 278 feet long, and at the top the rock is 42 feet thick and 33 feet [illegible] in the Cedar Breaks National Monument, near Bryce Canyon, and in the Arches National Monument. All have had an essentially similar origin— [illegible]

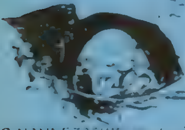
ELEVEN notable bridges and innumerable other minor ones are located in the southern half of Utah—a region which is undisputed champion in this respect. No accident of Nature is responsible for this abundance, but a combination of topographic and climatic circumstances, intimately connected with the history of the landscape

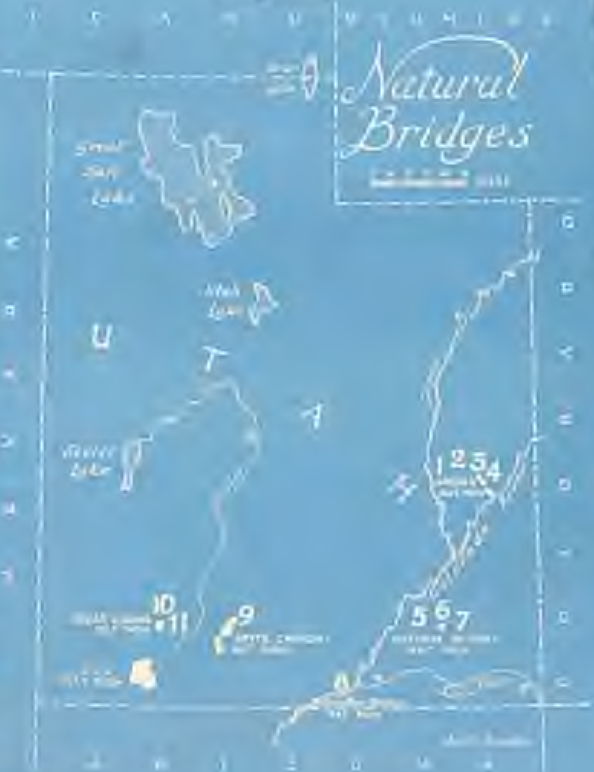
Drawings by Helen Babbit

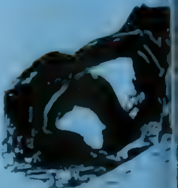

11 ASHDOWN

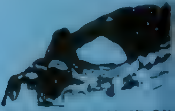

10 WALLS OF JERICHO

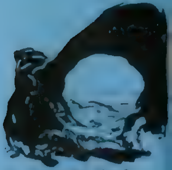

9 BRYCE CANYON

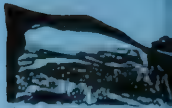

8 NONNEZOSHIE (Rainbow)

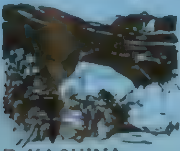

Natural Bridges
I D A H O
W Y O M I N G
N E V A D A
C O L O R A D O
A R I Z O N A
Great Salt Lake
Utah Lake
Sevier Lake
U
T
A
H
1 2 3 4
5 6 7
10
11
9

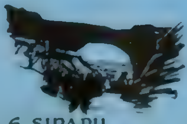

1 TWINBOW

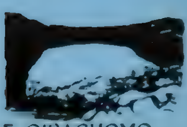

2 SOUTH WINDOW


3 DOUBLE-O


4 LANDSCAPE


7 KACHINA


6 SIPAPU


5 OWACHOMO

Knothole Cavern

By EDWIN WAY TEALE

All photographs by the author

The nighttime exploration of a Lilliputian lake carries a modern Gulliver far back through the pages of history and enables him to witness the truth regarding one of man's oldest misbeliefs

IT WAS ten o'clock at night and the month was September.

All around me, bushes and twisted trees—so familiar by daylight—stood mysterious and still, massed in silhouette against a faintly luminous sky. The night had engulfed in blackness the Long Island hillside where I had set out an insect garden filled with plants and shrubs to attract six-legged visitors. All visible life was concentrated into the little area illuminated by my flashlight.

Like an elongated finger, I moved its beam among the jungles of grass, across the bushes, into the trees. As the light swung from place to place, successive little realms of insect life were spotlighted in its rays. These worlds materialized and vanished with the pressure of my thumb.

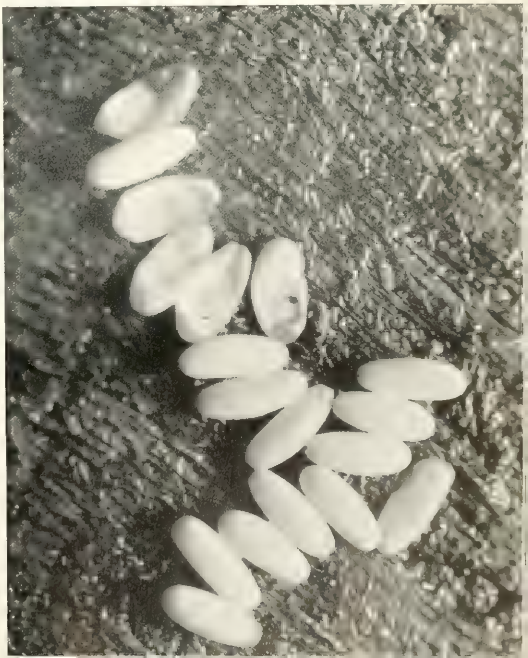
At times when I have been traveling by train on stormy nights, I have caught occasional glimpses of unfamiliar landscapes illuminated for a moment by flashes from the sky. They appeared and disappeared in an instant and they left me wishing I could see more clearly these isolated spots picked out at random by the chance glare of a thunderbolt. Something of the same feeling comes on nights when my beam shifts from point to point as I go exploring among the nocturnal dwellers of my garden. But there I can hold the lightning, so to speak, and keep the beam of my torch illuminating some scene of special interest.

Beneath an ancient apple tree, which has lifted its twisted branches above the hillside for more than half a century, I switched on the light. As the beam glided upward along the gray treetrunk, it encountered the black, unblinking eye of a knothole. A dozen times a day, in full sunlight, I had passed this opening without a second glance. But now, surrounded by darkness, this three-inch opening, five feet from the ground, assumed an added interest.

Rains from previous showers had collected within. The interior of the knothole, illuminated by my flashlight, resembled some subterranean lake, reduced with its underground cavern to miniature proportions. The weathered wood, sloping downward along the roof of this teacup-sized cave, had the appearance

▲ "AS THE LIGHT swung from place to place, worlds materialized and vanished . . . The beam encountered the black, unblinking eye of a knothole . . . like a subterranean lake reduced to miniature proportions"

THE TINY SNOW-WHITE EGGS might not attract attention if one did not know what a curious diver would emerge



[illegible] black ants were bending down at the edge of the water as though drinking on the shore of a lake.

Floating on the surface of this knothole pool was [illegible] ing from one dark corner to another with a baby sow bug clinging to its back. Under the lip of the opening, [illegible] long. Hanging from the surface film by the tips of their tails, they swung back and forth in steady, leisurely arcs. They brought to mind acrobats on gymnasium rings. Two, side by side, were swinging in [illegible] was that they were some sort of immature gnats living out the underwater stage of their existence.

[illegible] forms of the mosquito wigglers. Like slender, whitish tadpoles, these larvae moved with lashing tails. They started, stopped, darted forward again, whip-tails in [illegible] fish that swam in this Lilliputian pond.

Rising from the debris at the bottom of the flooded cavern were a score or more slender white stalks, apparently sprouts from seeds scattered singly and in little clusters. Between these pale vertical columns rising through the brown water, the tiny wigglers kept up their incessant and seemingly aimless darting and pausing.

As the beam of my flashlight shot low over the surface of the water, I observed a curious thing. The surface was not smooth. It contained a dozen dimples that suggested the "knots" in an imperfect pane of glass. Under each dimple hung from one to seven of the white sprouts. Where there were more than one, the thin stalks came together like the poles of a tepee. Some attraction seemed to pull them to a common center. Using a straw, I pushed apart one of these clusters. With a steady, stately motion, the component stalks swung back and assumed their former position.

The dimples above such clusters were larger than where a single sprout reached the surface. And here was another surprising thing. Not a single sprout [illegible] the surface and no farther. I was puzzling over this when an amazing thing took place before my eyes.

As I watched it, one of the white sprouts telescoped [illegible] It steadily became shorter until it disappeared in the debris below. The other stalks remained as before. The whitish wigglers kept up their endless darting and halting. And the little acrobats of the surface [illegible] oscillations.

World's first diving suits

But something had happened at the spot where the descending sprout had reached the debris. Half an inch of white was moving among the black decayed wood of the pond-bottom. In a flash, I knew. These were no sprouts. These slender, stalklike columns were the air-hoses of the world's first diving suits. At the bottom of my knothole cavern were not seeds but some of the strangest, most incredible children of the insect world.

[illegible] *Eristalis tenax*, a syrphid fly popularly known as the drone fly, feed upon decaying matter in such shallow pools of water. Their tubelike, telescoping tails reach to the surface and carry air to the creatures below. Aeons before man first appeared on earth, Nature thus invented the prototype of the diving gear. Reaumur, the great natural scientist of Eighteenth Century France, studied this curious larva and gave it its name. He called it "the rat-tailed maggot" and the name has stuck.

Although these whitish creatures are, at most, only two-thirds of an inch long, they can extend their remarkable tails as much as four inches to reach the surface air. In his pioneer experiments, Reaumur placed several larvae in a jar and added water little by little. He saw the extensible tails, formed of two tubes telescoping one inside the other, lengthen until they were eight times as long as the bodies of the creatures they supplied with air. When they had stretched to the limit, the tails were no thicker than horsehairs. If additional water were added, the larvae either crept up the side of the vessel or floated nearer to the surface within reach of the air supply.

Since that night when I first met *Eristalis tenax* in my knothole cavern, I have observed other phases of its strange life-story. I have found the snow-white eggs floating in rafts on the surface film of the brown water. I have seen and photographed the long-tailed larvae as they hatched. I have discovered over-wintering larvae frozen in solid cakes of ice and have thawed them out and seen them swim about unharmed. I have observed these curious creatures walking along the underside of the surface film, like a fly traversing the ceiling of a room.

In feeding among the decaying matter at the bottom of the knothole pond, the larvae make use of tiny hooklets, which are attached to a head that is soft and capable of changing its shape. Other hooklets form a double circle on the bottom of each of twelve of its fourteen stuffy feet. On the front pair of stubby legs, the hooklets point forward like fingernails.

At the end of its larval-period, the rat-tailed grub leaves the water. It changes from white to yellow. Its body becomes shorter and thicker. Its larval skin grows hard and opaque, forming the puparium within which the transformation into the adult fly occurs. Two pairs of horns develop at the head of this pupal case. They provide respiratory organs for the period of transformation.

The ancient myth

This period lasts from eight to ten days. At the end of that time, what appears to be a honeybee crawls from the pupal case. In size, shape, color, and furry thorax, the adult syrphid fly so closely resembles a bee that it has helped create one of the most persistent myths of science, the widespread belief in the ox-born bee. Such flies are often seen about the carcasses of animals, in the fluid of which they deposit their eggs. The ancients, mistaking them for honeybees, concluded that the latter were engendered in the decaying carcasses of larger animals.

Osten Sacken, the Russian scholar who devoted years of painstaking research to the study of this myth, shows how the misconception was shared by peoples in many parts of the world. More than half of the fourth *Georgic* by Virgil is devoted to a detailed description of the most efficient method of producing bees from oxen. Ovid relates how the death of one produces a thousand lives when a slain ox becomes a swarm of bees. In his *Geoponica,* Florentinus goes into minute detail in explaining how to produce the finest bees. A bullock, he states, should be beaten to death with clubs and its bruised body shut up in a room with the windows plastered over. After sprinkling thyme and cassia over the dead bullock, the carcass should be left in the closed room for from two to three weeks. At the end of that period, this ancient writer assures his readers, nothing will be left of the animal except the horns, bones, and hair. The flesh will have changed to great clusters of honeybees.

Even before the days of the Latin scholars, the Greek writers were referring to the ox-born bee in their epigrams. Archelos called bees "the streaming children of the decaying ox." Nicander declared that "wasps are the offspring of horses, as the bees are of oxen." Because of this fancied connection between bees and oxen, the ancients considered that the best material for smoking bees was ox-dung. In that fascinating catch-all of superstition and early science, the *Natural History* of Pliny the Elder, we learn that if bees die, they can be renewed by burying the carcass of an ox in dung.

Long before the rise of Greece, Egyptians along the mouth of the Nile went through a laborious ritual in producing bees from oxen. They buried the slain bullocks in the ground with only their horns sticking out. The horns were then sawed off. From these openings, as the carcass decayed, the bees were supposed to fly. Chinese and Japanese writings reveal that the idea of the ox-born bee was current in the Orient at a very early date.

In 1474, a book by Peter de Cresentiis suggested that bees might be "partly produced by bees and partly from decayed oxen," and the myth that a honey-gathering swarm owes its existence to the death of an ox has persisted until comparatively recent times. In fact, in remote sections of the world, it may still be accepted as true. The myth of the ox-born bee is one of those contagious misconceptions which have spread to many parts of the globe. It stands as a monument to the intellectual sloth of mankind. For the simplest kind of an experiment—an attempt to obtain honey from such insects—would at any time have proved its falsity.

A hitchhiker

Flies aplenty are produced as the ancients described, but not bees. Like the legend for which it is responsible, the fly, *Eristalis tenax,* has spread from one country to another. As a stowaway on shipboard, it has traveled widely. About the time of the Civil War the drone fly and its rat-tailed larvae were first recorded in America.

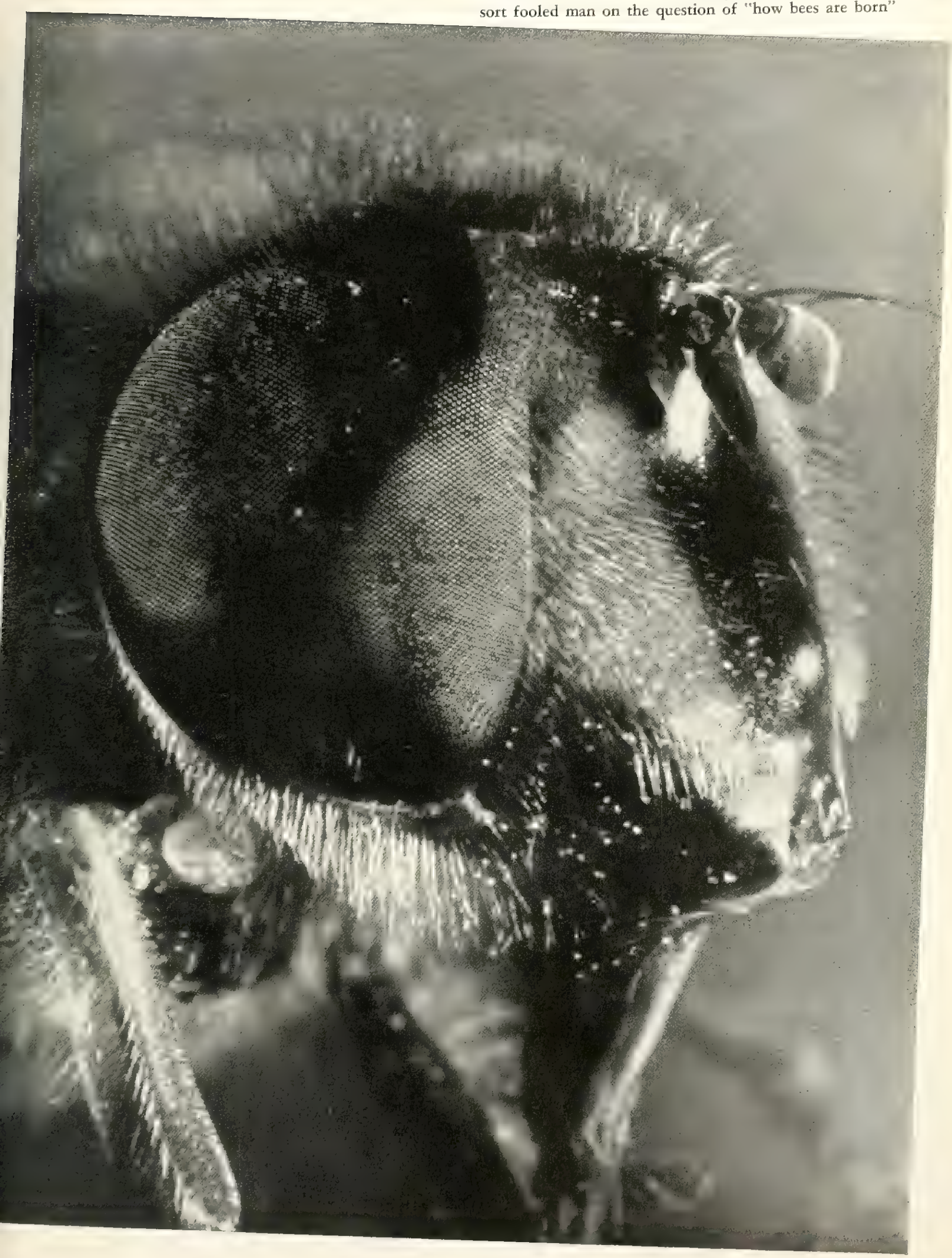
If not the identical species that Virgil and others had erroneously described as bees produced from oxen, the underwater larvae of my knothole with their telescoping "periscopes" were their close relatives. Instead of in decaying flesh, they developed in the decaying matter at the bottom of a knothole. The accompanying photographs show the knothole and what I found in it, as well as an adult syrphid fly, which later alighted on a flower nearby. You will note that an observer, particularly in the early days of natural science, might suppose that it was a bee. For me, the story of these insects took on added interest, because I had picked up the thread of their history under unusual circumstances, because within the space of a knothole cavern my flashlight had illuminated the silent drama of their early lives.

◄ EQUIPPED with an air-hose that telescopes out to eight times its body length, the little animal maintains contact with the air at the surface of the water. When extended to the limit, the tube is no thicker than a horse hair

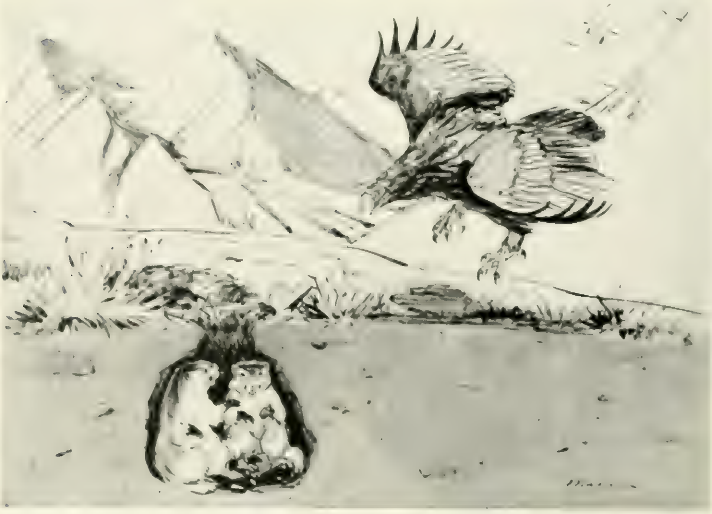
► THE LARVAE feed on decaying matter and by a remarkable transformation become winged creatures in due time

▼ WHAT appears to be a honey bee crawls from the pupal case. The ancients could easily have proved that it was not one, by trying to obtain honey from it

Greatly enlarged, the head of a male syrphid fly looks more formidable than the creature really is. For centuries, flies of this sort fooled man on the question of "how bees are born"



AIR RAID SHELTER



By John Eric Hill

Drawn by

G. Frederick Mason

IN times like the present everybody is conscious of the menace of attack from the air and the need of shelter. Many animals, too, have aerial enemies from whose swift attack they need protection. Meadow mice use grass runways to escape the hawks and rarely come out into the open. Pocket gophers spend most of their lives in underground tunnels because of similar foes. But the hoary marmots, huddled in the shallow shelter-hole to escape the eagle, show the closest resemblance to men in an air raid shelter.

Hoary marmots, or whistlers, are larger, grayish cousins of the woodchuck. Their silky fur is creamy white, mixed with blackish, except for the rump which is rusty and the feet which are black; and they are among the most handsome rodents of North America. They are found in the western mountains, from northern Washington and central Montana to Alaska. In the southern part of this range the hoary marmots are restricted to the mountains above timberline, but in Alaska they occur near sea level.

These two marmots were feeding on the lush grass and tasty weeds of the mountain meadow. They wandered farther and farther from the safety of their home burrow, which was at the edge of the meadow, eating greedily until their paunches bulged with the green food. (Marmots must put on thick layers of fat for their long winter sleep.)

A golden eagle, sailing high in the air, sighted the busy marmots and wheeled in their direction. The far-off movement was seen by an old marmot, resting on the top of a boulder. Immediately the watcher gave a piercing whistle of warning. All the marmots of the little colony dived for their burrows; but the two out on the meadow were too far away from home, and the eagle was coming on like a bolt of lightning. The shallow hole was near, and the two tumbled into it with not a moment to spare.

The home burrow of the whistler is usually under and among large boulders or in rock slides, where they cannot be dug out. They often have shelter-holes along the pathways that lead from the burrow — holes which were perhaps dug in play by young marmots or perhaps started as homes and abandoned. Whatever the origin of the holes, they are good protection from the eagle, provided the refuge can be reached in time, and the golden eagle is one of the chief enemies of these rodents. The frightened marmot, however, that runs into one of these shallow holes to escape a grizzly bear, its other major enemy, is almost certain to fall victim to bruin.

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A MONARCH AND HIS COURT

Saved from white man's ravages

By L. CONWAY EVANS

IN the heart of the Waipoua Forest in the North Island of New Zealand stands Tane-mahuta, greatest of kauri trees, a fortunate survivor from early times when he and his kind reared their giant trunks all over the land. But then came evil days when after centuries of sturdy growth the ruthless white man hacked and burned the denizens of the "Bush" which those he was pleased to regard as savages, had loved and reverenced.

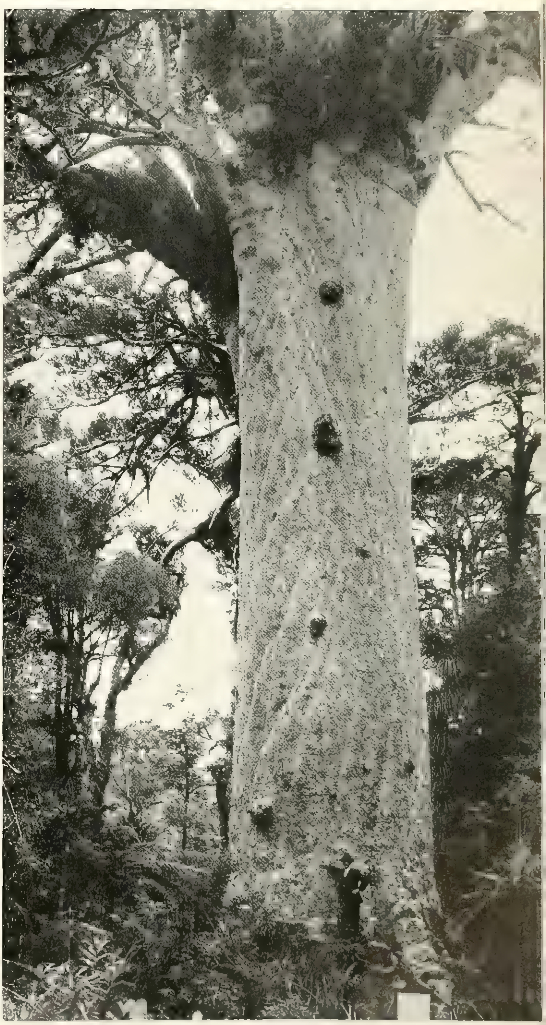
The Maori name Tane-mahuta means King, or rather God of the Forest, the original name of the deity who according to native mythology played a leading part in the story of creation. For in the beginning there was naught but darkness, night impenetrable. Mother Earth, known to her children later as "Papa" existed, but Rangi, the Sky, lay close upon her, and the gods who were awaiting birth lay crushed in the elemental embrace. There were many: Tane-mahuta of the Forest, and the gods of Winds and Storms, of Oceans and Volcanoes, of Earthquakes, of Peace and War, and with War was associated Man and warlike arts.

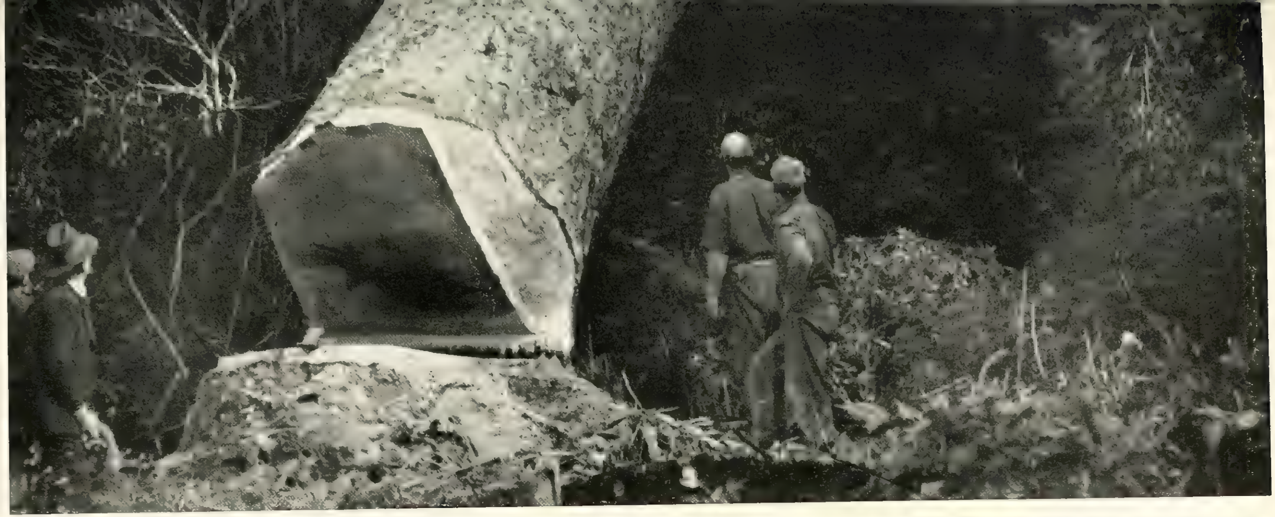
And it was Tane, as he is now generally known, who was the liberator, Tane, God of the Forest, who caused his mighty primeval trees to force his parents apart so that light flooded the world and the gods were freed. No wonder then that he was worshipped and his children venerated in the forest which was sacred, or *tapu.* But sometimes the Maoris would require the services of one of the giants. If they had to build a new war canoe they needed a long straight tree trunk, but before chopping it down they had first to invoke Tane and then propitiate him, and the whole ceremony of felling was carried out under the direction of a priest of the tribe and enacted with much ritual. The threatened trunk was struck with a stick to which a leaf was attached, a special fire was kindled in which the first chips were burned, the relays of fellers who worked with stone adzes were themselves *tapu,* wearing but one garment apiece made for them by the older women of the tribe, and eating no food while employed on this task, which no woman might witness.

Ignorant of all this, an early French expedition led by Marion du Fresne met with its doom in the dense Bush. New spars were needed, and spars were made out of wood, a very usual and prosaic commodity. The Frenchmen found marvelous forests with trees the like of which had not been seen by Europeans before, for Cook had not penetrated sufficiently far inland to discover them. They were enthusiastic about this "kind of cedar with the leaves of an olive color and very resinous. The resin is white and transparent and gives out an agreeable odor when burned." Pleased with their find they proceeded to destroy. But Tane had been outraged, and the Frenchmen paid for their sacrilege with their lives.

And who can tell how much of the bitterness of

▼ AS A MONUMENT against destruction of natural resources, Tane-mahuta raises its purplish gray trunk 42 feet into the air without a single branch. Note the man at the base, dwarfed in comparison with the tree's 43-foot girth. This is the largest kauri tree in the world, and it has lived well over a thousand years





▲ ALTHOUGH this lesser giant was flourishing when Columbus discovered America, man now deems it necessary to fell it

A. N. BRECKON PHOTOS FROM THREE LIONS

▼ IT TAKES four men to jack this huge kauri log onto a truck for transport to the mill. Note the clean surface of the tree. From time to time the kauri sheds great flakes of bark, leaving a clean surface pitted with strange patterns in which some have seen the original designs of many native New Zealand carvings

▼ IN THE early days bullock teams were used to bring out the logs where there was no suitable waterway. Now tramways have been laid down through the kauri forest areas, but the colorful bullock team still persists in some localities

▼ OPENING OF A dam will wash these hundreds of kauri logs down stream to the milling plant. A single kauri has been known to produce as much as 72,000 feet of lumber

▲ "[illegible] Not a single bough"—a clump of kauri trees protected in the Waipoua State Forest in New Zealand, whose vertical shafts stand as a lasting symbol of the majesty of this unique tree and of man's forethought

the Maori Wars now happily relegated to the past had their [illegible] in the wanton destruction of Tane's [illegible] kingdom. Today there are miles and miles of waste land quite unsuitable for pasture, with blackened stumps to tell of a destruction whose ruthlessness is only paralleled by its stupidity. Native trees of all kinds have been sacrificed, but the destruction of the kauri is the saddest of all because of its slow growth. Should a young man plant a seed from one of the tiny cones he would not see much result during his allotted span of life, and experts are willing to accord an age of 1200 to 2000 years to the giants which still remain in the now fortunately preserved areas such as Waipoua Forest and Trounson Park.

It is in the former that Tane-mahuta holds his court. Main road and motorcars are left behind. The approach is by a path paved with the hairy trunks of tree ferns through a tangled wood of incomparable beauty. Trees of many varieties are roped together with lianas and offer their bare bodies to innumerable ferns, mosses, and epiphytes. The forest is full of music, of the silver notes of the tui (parson bird), the gay rippling song of the gray warbler, the call of the shining cuckoo heralding his majesty. And there stands the hoary old monarch carefully protected by a stout fence from his enemy, Man, for as a companion aptly quoted:

> [illegible]
> [illegible]

—and vulgarians see nothing amiss in carving their ephemeral names on trees which may have existed when Christ walked in Galilee.

[illegible] in the case, however, would not [illegible] the kauri has a wonderful [illegible] by which it can rid itself of an [illegible] That is the reason why, in a country in which nearly every other tree is smothered in the [illegible] of [illegible] the kauri alone stands out chaste and clearly defined. From time to time [illegible] of bark are shed leaving a clean surface beneath, pitted with strange patterns in which some have seen the original designs of many Maori carvings.

A board records the actual facts concerning the monarch and tells that his girth is 43 feet, that he reaches a height of 42 feet before he puts out a branch, and that he provided 72,000 super feet of timber. This may be of interest to some. I would sooner remember his majesty than his measurements. But though he is the biggest of all the trees, yet perhaps his courtiers in Trounson Park show to better advantage, because there they have the place to themselves, and one sees the grandeur of the mighty purplish gray trunks as they stood throughout the centuries. Columns in a Gothic cathedral are often said to resemble trees in a forest. There is nothing Gothic about the kauri's growth. The trees are Norman in their solidarity and immense girth. The trunks soar upwards for some 40 feet before branches interfere, and the branches show their age far more than the trunks. The small leaves clustered around them, like those of the araucarian monkey-puzzle, are not especially beautiful. The cones, which bear male and female flowers on the same tree, are remarkably small, reminding one that colossi such as they and the giant sequoias are propagated by very tiny offspring.

Kauri gum

The fact that the trunks rear their heads aloft without tapering makes the trees of immense value, and the quality of the wood has a remarkable combination of strength, lightness, and durability. But apart from the value of the actual timber there is a by-product which has brought much wealth to man and has not necessitated destruction. That is the so-called kauri gum, which is a substitute for amber and is used in the production of first-class varnishes. It was the resin to which du Fresne made reference, and it oozes from the tree wherever wounded and trickles down from its crown. The flakes of bark that fall from the trunk are impregnated with it, and when they decay in the ground the resin becomes fosilized and is converted into the precious substance which was eagerly sought for by diggers in the past. These diggers—Dalmatian for the most part—collected it in dust, in chips, or in nuts. Fortunes have been made overnight when the collector has come round to buy up the yields en bloc. And they have been lost as speedily, for Dalmatian diggers were notorious gamblers.

But times have changed here as elsewhere. We live in a synthetic age, and it is a wise man who can tell from what anything is made. Tourists still buy the gum with strange creatures within it, but it is more an object of interest than of value.

Tane-mahuta has seen much in his long life.

Autumn's Brilliance on the New Kodacolor

By CHARLES H. COLES

Chief Photographer of the American Museum of Natural History

As the vivid hues of fall foliage once again flash over the wooded hillside, we have a new medium with which to record these colors for future enjoyment. Kodacolor makes it possible now for owners of all roll film cameras (excluding miniatures) to make color shots and see them on paper as a print.

While the new color film is simplicity itself to use, a glance at some of its limitations may improve results. Although the exposure latitude of Kodacolor is far greater than that of Kodachrome, it must be remembered that a transparency is always superior to a print in its ability to record wide ranges of brilliancy. Many persons do not clearly understand this. A black and white film, for example, will properly record objects that differ in brightness by over 100 times, but this range is of small value if it cannot be transferred to the print. Ordinary printing paper will record a brightness difference of only 40 times; hence details that were recorded by the film in the extreme shadows and high lights may be lost on the paper. If this same film were printed onto a lantern slide and thrown on a screen, its full scale of tones would be preserved. This is the fundamental advantage of a transparency over a print on paper.

Kodacolor film has a large tolerance for exposure errors and brilliancy differences, but the paper upon which it is printed has the usual restrictions in brightness range. Therefore, if the original subject has great differences in brightness, the paper may not be able to encompass the entire range. Similarly in the use of Kodachrome, the brightness range of the transparency is apt to be greater than a Minicolor print made from it.

Thus the photographer using Kodacolor should remember that his finished print will appear more pleasing when the brightness range of the original subject is restricted to rather small limits, that is, when the brightest object is not more than 3 or 4 times as bright as the darkest shadow in which good color rendition is wanted. This difference can be measured with an exposure meter, and if it is too great it should be adjusted by the proper use of reflectors.

Taking pictures in full sunshine always presents the problem of excessive contrast. Suppose we are taking a photograph of the red fruit of the sumac, growing at the edge of the autumn woods with sunlight shining through the trees upon it. The contrast will be very high, ranging from full sunlight to deep shadow. A color picture of this subject can be exposed for either the high lights or the shadows, but not both. In order to raise the shadow side to an intensity comparable with that of the sunlighted side, it will be necessary to use a reflector. A piece of white paper or card will do the trick nicely or, better, a card covered with a sheet of metal foil that has been crumpled and straightened out again before being cemented to the card. The size of the reflector depends mainly on how large an object is to be photographed. The reflector catches the sunlight and throws it onto the shadow side of the shrub.

Startlingly beautiful color prints may be made almost entirely by the use of light from a reflector. Move around to the shadow side of a tall yellow goldenrod so that the sunlight illuminates only the outline of the flower. Now use the reflector just alongside the camera to redirect sunlight onto the plant. In this way a flat light will fall upon the flower and the sun will edge-light each spike of blossoms.

Almost all the most striking close-ups in color that you see in magazines are made with this combination of sunlight and reflector. With larger objects an exposure meter can be used to measure both the high light and the shadow brightness. It is then possible to adjust the shadow brightness with the reflector until it measures ¼ or ⅓ as much as the high lights. When this balance is achieved, good color rendition will be obtained in both the high lights and the shadows.

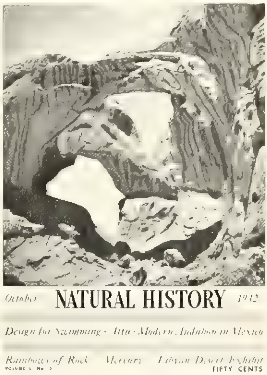
Almost any camera may be used for Kodacolor, even a box Brownie. The colors will, however, be rendered more accurately by a camera with a better lens, since the more complex lenses are corrected for better focusing of the various colors. What is more, the box camera can be used only in bright summer sunshine because of the small aperture of the lens.

Since Kodacolor is corrected for sunlight, any variation from this type of lighting will have an effect upon the color. The familiar bluishness of pictures made in the shade will remind us of similar effects obtained with Kodachrome. Here the use of a 2A filter will help to overcome the blue color of light coming from blue sky alone untempered by sunlight.

Kodacolor does not yet give as good color rendition as Kodachrome, but its deficiencies will doubtless be remedied in time, as was the case with Kodachrome. A great advantage of Kodacolor is that black and white enlargements can be made from it as easily as from a regular negative. It has been suggested that an orthochromatic enlarging paper such as Varigam be used to make the enlargements, so that you will achieve gradations of light and shade which closely match the brightness values of the colors recorded in the negative.

The greatest drawback of Kodacolor as yet is the inability of the manufacturer to supply large color prints. Kodachrome has this advantage. An enlarged print can be made from it by the Kotavachrome process, in addition to the fact that the transparency can be projected on a screen as a lantern slide. However, Kodacolor is the answer to the amateur's demand for an inexpensive color print which can be pasted in an album or viewed at any time without setting up a projector.

THE COVER THIS MONTH


October
NATURAL HISTORY
1942
Design for Swimming · Itta · Modern Audubon in Mexico
Rainbows of Rock · Mercury · Libyan Desert Exhibit
VOLUME L No. 3
FIFTY CENTS

"The Jug-handles" is the popular name for Twinbow Arch, depicted in full color on the cover of this issue. This remarkable formation is located in southeastern Utah, in the Arches National Monument, and can be reached by automobile over a winding, uneven road a few miles north of Moab.

The sun pouring through the enormous span plays strange tricks on the brilliantly colored rocks. Once thought to be a freak of nature, the structure is now known to have been carved by a river in search of the easiest route toward the sea. The gap in the larger arch is 165 feet wide and 156 feet high, and the total represents a tremendous weight of rock removed by the slow processes of erosion. There are 31 arches in this section of the Monument.

The Kodachrome was taken by Ralph Calvert, who used an Argus camera set at 1/60 second at f 6.3, with a haze filter. For further discussion of natural bridges and their formation, see "Rainbows of Rock," by H. E. Vokes, on page 148.

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THE MEDITERRANEAN SAGA OF A SEA

by Emil Ludwig

Whittlesey House, [illegible]

I[illegible] is inevitably more complicated and even, [illegible] the words of the author: "The Mediterranean is the loveliest of all seas, favored by situ[illegible] and likewise before all others discovered and sailed. This is the Helen among [illegible] saw it, and captured by the boldest. But it was fought over not for ten but for two thousand years. Then it was half-forsaken, obscured by the fame of new and distant oceans; rediscovered, as it were, after three hundred years; and today, before our eyes, it is fought over anew."

There is not much that is true "natural history" in the book, although there is some discussion of the physiography of the sea bottom and of the shore regions, together with a consideration of the various air and water currents, with particular attention [illegible] the region.

The story of this book is the story of the growth of the civilized world as evidenced in the history of one of its great crossroads. From the days of the first communities of the East down through all the years to the great convoy battles of today, the Mediterranean has lived an eventful and kaleidoscopic life; as told here, it makes fascinating, entertaining, and withal, most [illegible].

H. E. [illegible]

THE AMATEUR SCIENTIST

by W. Stephen Thomas

W. W. Norton, [illegible]

IN this time of national emergency it should be encouraging to all to know that there are many thousands of amateur scientists in this country. It should be even more encouraging to know that careful consideration is being given by national scientific organizations and by the government to the efforts and abilities of these [illegible] the general public. Some of the many who "ride a hobby" may be surprised to know [illegible] can be considered scientific.

This book, which is in part a report of the study of amateur scientists in the Philadelphia area conducted by the Committee on Education and Participation in Science, of the American Philosophical Society, shows conclusively that the efforts of amateur scientists can be increased in value if those efforts are directed and co-ordinated.

The author is wise to point out early in his book the fact "that science is a neutral device and not an instrument that can be labelled good or evil." Thus, science, in itself, is no cure-all. However, free men and women who know how to use the scientific method can, if they will, use that method to add to the general well being of mankind. Readers of this book should be impressed by the fact that the Philadelphia experiment, in which 500 amateur scientists took part, was not only a success, but showed that amateurs were more than willing to devote their time and effort to a good cause without any consideration of compensation other than that afforded by the feeling of participating in a scientific endeavor. As long as the amateur American scientists are more interested in their work than they are in receiving compensation for that work, the future of American science seems fully assured.

JOHN SAUNDERS

MAN'S MOST DANGEROUS MYTH: THE FALLACY OF RACE

by M. F. Ashley Montagu

Columbia University Press, $2.25

THIS is a wartime book directed against the Nazi doctrine of the superiority of the German race. The general reader will not find it easy reading unless he is familiar with several divisions of knowledge. To state the thesis of a book in simple language is never quite fair, but it is not far wrong to state that the author stands for the literal implication of the Declaration of Independence that "all men are created equal." He believes this is worth fighting for and that we are fighting for it. He argues that there is but one race, the human race, and that all are potentially equal if given equal opportunities. He believes that animals and plants can be consistently classified biologically but that it is impossible to classify human beings in [illegible] use of the word *race* is recommended, but "ethnic group" is regarded as the proper [illegible] what is said to have no existence? One way to eliminate race prejudice is noted, viz, to so mix populations that all will look [illegible]. However, the author is far from sure that such a solution is desirable, if [illegible] is that it does not exist in nature, that when animals kill they are not making war nor fighting because they like it. Savage men, also, the author claims, do not make war when they raid and kill, but he maintains that war came in with civilization. Yet he thinks war is not a necessary part of civilization and so civilization need not be destroyed to abolish war. Readers enjoying argumentative writing will find the book provocative.

C. W.

THE CHANGING INDIAN

Edited by Oliver La Farge

University of Oklahoma Press, $2[illegible]

THIS interesting discussion of the status and problems of the Indian of today consists of a symposium of seventeen papers arranged by the American Association on Indian Affairs. The introduction was written by John Collier, United States Commissioner of Indian Affairs. One of the papers, entitled "The Mixed-Blood Indian," was contributed by Dr. H. L. Shapiro, Chairman of the Department of Anthropology, American Museum of Natural History. The paper on "Land Tenure in Aboriginal America" is by Dr. Ralph M. Linton, Professor of Anthropology in Columbia University. There is not space here to mention each author and his contribution separately, but we must be content to state that all the contributors are among the foremost students of American Indian life. The editor, Mr. La Farge, is President of the American Association on Indian Affairs and is widely known through his books *Laughing Boy, The Enemy Gods* and *As Long as the Grass Shall Grow.*

"There is more than paradox," says Doctor Shapiro, "in the fact that the American Indian has become an alien in a country once his by possession, and more than irony in the fact that he is looked upon as a social problem where his ancestors reigned supreme. But whether or not we object to regarding the Indians as a problem, their status has been reduced to that of a minority group, and their success judged by the degree to which they can assimilate our culture or come to some working terms with it."

The Indians are now increasing rapidly. Today there are about 380,000 in the United States; by 1980 it is estimated that there will be 700,000—perhaps a million by the century's end. How can these be supported on land that is not nearly adequate for the present numbers?

Some of the problems dealt with in this important book are the salvaging of the unfortunate land allotment, land use planning, and Indian health and education. It is the 23rd volume to be included by the University of Oklahoma Press in its excellent series of the "CIVILIZATION OF THE AMERICAN INDIAN."

CLYDE FISHER.

JUNGLE PEOPLE

by Jules Henry

J. J. Augustin, $3.50

THE jungle people of this book are the Kaingang (sometimes known as Botocudo) dwelling in the state of Santa Catarina in Brazil. A generation ago they lived a wild, nomadic life, making forays from time to time on the Brazilians and slaughtering them. Their existence was largely a struggle to gain a livelihood from the jungle with the primitive means at their disposal. To this extent the Kaingang are not especially remarkable, since many other uncivilized groups share with them similar preoccupations. The Kaingang, however, were remarkable in the extraordinary development to which they carried the feud. Within the same tribe families killed each other off to avenge one of their members. So fierce was this disruptive force that the passage of years did little to soften its power. Indeed, the feud seemed well capable of destroying the whole society. In the grip of its demands, no one felt safe except those who had ties established by relationships or by bodily contact through years of living and sleeping together.

If the feud tended to destroy their society, the female managed to hold it together by forming a nucleus around which one or more males might form a co-operative hunting unit.

Among the Kaingang the fundamental passions of life are reduced to their elemental forms and given full rein. Doctor Henry who lived (for more than a year) among these often savage people has written an account of their lives that highlights these elements. He gives his readers an absorbing "profile" of a jungle people.

H. L. S.

MY FRIENDS THE APES

by Belle Benchley

Little, Brown and Co., $3.00

MRS. BENCHLEY divides her book into four parts, devoting one section to each group of apes, beginning with the gibbons and progressing to the orangutans, chimpanzees, and gorillas.

She gives some interesting information about the history of each group of apes, using as authority for her statements the conclusions of explorers and students of natural history in this field. Her position as Director of the San Diego Zoo has enabled her to observe these animals constantly and over a long period of years. The gibbons are presented as graceful acrobats with an incredible sense of balance, which permits them to swing through the air and land with precision and instant repose. The sounds which the mother gibbon makes in crooning to her baby contrast remarkably with the clean ringing full-voiced song with which that same gibbon greets the dawn.

From Mrs. Benchley's experiences the orangutans show the greatest mechanical ability of all the apes; which combined with great strength, weighty bodies, and long arms to aid in leverage, makes it necessary for the keepers responsible for them to use great ingenuity in devising locks and bars which cannot be opened or pried apart.

The chimpanzees seem to have the least hold on Mrs. Benchley's affections—although she admits the appeal of these animals in babyhood.

San Diego Zoo has been fortunate in owning four gorillas, of which two are still living. These grand animals have Mrs. Benchley's whole-hearted admiration and affection. From their first arrival at the Zoo she has felt a sense of responsibility toward them and has kept a careful diary recording the smallest details of their behavior and appearance. Simple playthings have been provided and the animals have been happy, active, and healthy.

YVONNE RAVEN.

BIRDS ACROSS THE SKY

by Florence Page Jaques

Harper & Brothers, $2.50

THE Jaques can be counted upon to make a beautiful book, and this one maintains the standard set by their earlier creations.

Francis Lee Jaques is a master of the strong chiaroscuro of black-and-white, of which more than 25 examples illustrate and adorn his wife's sprightly text. Anyone who, after looking at such a plate as the widgeon among cypresses, on page 91, thinks that the medium lacks "color," must have a blind spot, indeed. His pictures skip far across the world, following the narrative from Alps to Canal Zone, from Alaska to the Gulf of Mexico. Aside from the beauty of line and mass, they possess other appealing attributes such as cold austerity in "Matterhorn," humor in the "Bird Club in Spring," and restrained pathos in "Grey of Falloden."

Diverse as is the content of the twelve chapters, at least two common threads run through them. These are: (1) discovery of the charm of birds by a sensitive adult under the influence of another who had been steeped in it since childhood; (2) emphasis on the observation, travel, intensive study, and technical skill that are demanded for building certain types of exhibits in modern natural history museums. Enjoying the advantages of a whimsical pen and the close companionship of her husband and his professional friends, Florence Page Jaques makes good use of her enviable opportunities. Persons and fascinating places are reflected as faithfully as birds and other wild life.

Once in a while the author's memory slips a cog, as when she waves her husband off on a long Pacific voyage in a "thirty-foot yacht"—it was really longer by a hundred feet—, but in the main her descriptions are no less factual than artistic. So wide and rich is the geographic gamut, and so individual the charm of each event, that it might almost annoy her to hear this reviewer's opinion that the high spot of the book, in action, suspense, drama, and even in ornithological interest centers about a family of barn owls in the garret of an old manse only a few miles from the heart of New York.

R. C. M.

CLIMATOLOGY

by Thomas A. Blair

Prentice-Hall Co., $5.00

ARE you interested in the average temperature and rainfall for each month of the year in Pontianak, Borneo, in Zanzibar, Jerusalem or Rome, Archangel or Omaha? These facts are all to be found in this book. And not only will you find the actual figures, here also is a concise discussion of the climates of all parts of the world.

Doctor Blair, of the United States Weather Bureau Office at Lincoln, Nebraska, has written a book which from the viewpoint of the non-specialist is easily understandable, fully readable, and nevertheless almost encyclopedic in content. The subject is, in fact, the entire field of climates,—the agents which comprise them, the factors which influence them, their effect on agriculture, architecture, etc., and lastly a summary of the climates of the whole world. The compaction of all this material into a single volume, written in non-technical terminology and style is a monumental undertaking. Doctor Blair has succeeded in his attempt to achieve this goal.

H. E. VOKES.

KLEE WYCK

by Emily Carr

Farrar & Rinehart, $2.50

WHEN a schoolgirl of fifteen, Emily Carr with paper and paints first went among the Indians of the Canadian West Coast. These simple people with their colorful totem poles absorbed her attention for many years. She would undergo the greatest hardships in order to visit an abandoned village, where she could paint these poles carved from the trunks of trees. There seemed to be an aesthetic harmony between the native artist who made the huge carvings and the white girl artist who made the paintings of them.

As Emily Carr says, the totem-pole artist "wanted some way of showing people things that were in his mind, things about the creatures and about himself and their relation to each other. He cut forms to fit

Continued on page 168

[illegible]

[illegible]

Sirs:

[illegible] year's issues have been filled with information that has correlated wonderfully well with my natural science subjects. [illegible] hardly wait until the next issue arrives . . .

Evelyn C. Roth.

Chicago, Ill.

Sirs:

. . . May I congratulate you upon the [illegible] point of view it is the finest magazine published in the United States today. The illustrations are excellent! The articles are [illegible] to read.

[illegible]

Sirs:

For several years I have been a subscriber to your magazine; I had it sent to me at the school where I was teaching in Evanston, Illinois, until a year or so ago, [illegible] subscription transferred to the Library of [illegible] 1942 [illegible] in the West and neglected to renew this subscription (which I find is much appreciated by the college). Could you accept now the subscription for 1942, send the back numbers and those to come this fall, so that the year's issues can be bound? In any case, please continue the magazine . . .

[illegible]azine. I have not seen a copy but I think I may wish to send in one or more subscriptions . . . If it approaches the regular magazine, I am sure it is good . . .

[illegible]

Glennie, Mich.

Sirs:

Since writing you on the 7th of November last, I have duly received the copies of your magazine, which, I may assure you, I have read with the greatest of pleasure and interest. I have passed the magazine [illegible] most excellent and instructive journal.

[illegible]

Melbourne, Au

Sirs:

[illegible] even one number of it. Thank you.

[illegible]

[illegible]

Sirs:

. . . We do not wish to miss any issues, for they will be invaluable to our children when they are older.

[illegible] K. W[illegible]

South Hadley, Mass.

Sirs:

[illegible] for membership as an Annual Member for the first time. I have been an Associate [illegible] I have been a student in the past years, which made only the Associate Membership possible. I feel now that I am nearer the goal of doing all that I would like to do for the American Museum of Natural History.

My visits to the Museum have been many; all of the visits have been interesting and mentally stimulating.

Natural History Magazine has relieved the hunger of a nature-starved city dweller. Words from me are not necessary to describe such a fine publication; it speaks for itself.

I hope this world-spread chaos will interfere as little as possible with your great work, which will outlive the memory of [illegible]

John A. Lundin.

Brooklyn, N. Y.

Sirs:

The article, "Quinine," in your September issue is very interesting. I note, however, what appears to be an erroneous date, resulting apparently from the interchange of two figures.

The text reads: "[cinchona] . . . remained botanically unidentified until 1753, when the French Government sent a scientific expedition to South America." I believe the year of that expedition was 1735. The *Britannica* says that Jussieu, who accompanied it, ". . . remained in South [illegible] years, as you have it. The earlier date is also implied in Clairaut's *Theorie de la* [illegible]

[illegible]

Jackson Heights, L. I., N. Y.

The history of quinine contains numerous conflicting statements, but as [illegible] Doctor Comstock points out, the correct date seems to be 1735, the other presumably having originated through the transposition of two figures.—*Ed.*

• • •

Sirs:

Since we began to receive Natural History Magazine last year we have been very proud of our new membership in the Museum and look forward eagerly to each issue. The quality of the illustrations, particularly the beautiful cover photographs, and the variety of well-written articles are remarkable, and altogether we consider this the most indispensable of the periodicals which we receive.

We were interested especially in the panoramic view of the Goosenecks of the San Juan River which you published in your issue of last May. Because of the isolated location of this remarkable canyon, it probably is one of the least photographed of America's natural wonders, and we were surprised to see in print a picture that is almost a duplicate of our own—even to the arched effect caused by tilting the tripod canyonward.

The day after our picture was taken, which was two years ago, we began a seven-day journey by rowboat down the San Juan, through its desolate winding canyons, to the Colorado River and thence through spectacular Glen Canyon to Lees Ferry. Every mile of this water route through the desert is a new adventure, and although we negotiated every rapid safely, our trip almost ended prematurely in disaster by an impingement against a sheer sandstone cliff in the Great Bend.

The entire journey was an exhilarating experience and well worth the risks, and we were able to bring back a collection of photographs, in black-and-white and in color, of a country which has been seen by few white men. It is a gigantic colorful rock garden, but so inhospitable that it was shunned even by the Indians.

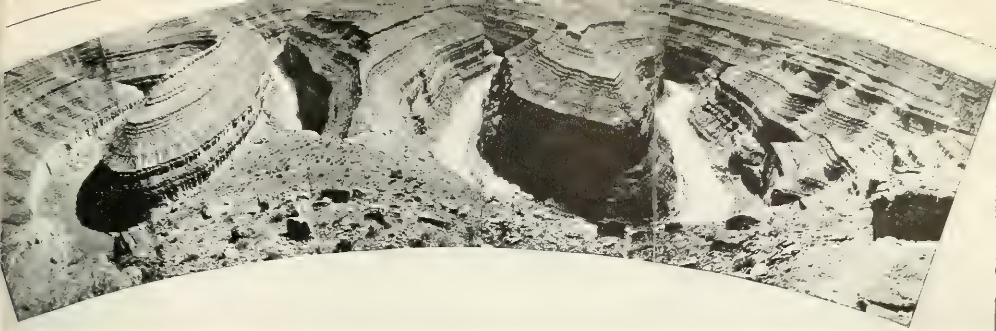
Thinking that your readers might like to know what the "Goosenecks" look like from the inside, we are enclosing a few photographs of that portion of the San Juan Canyons. The horizontal scene is a view of the point from which your picture was taken, and it shows the river at the place where parts 2 and 3 of the panorama are joined. The turbulence of the water in the other views is characteristic of the San Juan but cannot be seen from the rim of the canyon. The "ripples" visible in parts of your panorama are a type of current waves rising about five or six feet from trough to crest—just another example of the magnificence of the desert river canyons.

Mr. and Mrs. [illegible]

Wichita, Kans.

NOTICE

READERS are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.



How the Goosenecks Look from Below

Views taken from a rowboat by Mr. and Mrs. John E. Galley, whose trip through the rapids between the Goosenecks and Lees Ferry on the Colorado is described in the letter opposite

THE SCENE at left is a view of the point from which the panorama above was photographed. It shows the river at the place where sections 2 and 3 of the panorama are joined

THE TURBULENCE of the water of the San Juan is not apparent from the rim. Ripples scarcely visible in the panorama are five- or six-foot waves

[illegible] has no fear, is not stuck up, and knows how to laugh,"—and she lived up to this evalu[illegible]

The author has not rushed into print; [illegible] when she was fifteen, are now published when she is three score and ten. The 21 short stories which make up the book are separate as paintings, but closely related to each other. They are intimate stories of the lives of these people, human experiences, many poignantly sad, but told with [illegible]

[illegible]

BIOLOGICAL SYMPOSIA VOLUME 8

Edited by Robert Redfield

The Jaques Cattell Press, $2.50

IN [illegible] eleven papers dealing with various types of physiological and sociological integration [illegible] by biologists and social scientists range from a discussion of the problems involved in the transition from unicellular to multicellular forms of life, written by Dr. Libbie H. Hyman, to a concluding treatment of integration in modern society, by Dr. Robert E. Park. The scope of the symposium is indicated by the titles of the other separate papers, which are as follows: "Intermediate Levels of Organismic Integration," Dr. J. William Buchanan; "Higher Levels of Integration," Dr. R. W. Gerard; "Synergistic Aspects of Bacterial Populations," Dr. William Burrows; "The Transition from the Individual to the Social Level," Dr. H. S. Jennings; "Integration in Intra-Social Insect Populations," Dr. Thomas Park; "Social Dominance and Subordination [illegible] Vertebrates," Dr. W. C. Allee; "Basic Comparisons of Human and Insect Societies," Dr. Alfred E. Emerson; "Societies of Monkeys and Apes," Dr. C. R. Carpenter; and "The Societies of Primitive Man," Dr. A. L. Kroeber.

A comprehensive introduction by Dr. Robert Redfield includes detailed comments on each paper, together with a critical interpretation of the entire series. Despite the fact that the various treatments represent somewhat divergent scientific disciplines the volume as a whole is remarkably unified in its outlook.

Many of the chapters might prove difficult for the lay reader, but this collection [illegible] extremely important topic. The organization is such that individual papers are complete and intelligible in themselves. The volume can be read piece-meal, allowing the reader to pick and choose as his interests dictate.

[illegible] of the scientific times." Leading thinkers in different fields of scientific endeavor are bringing their thoughts to bear on common problems of extreme social significance. This volume of papers amply proves the value of such a procedure, and justifies the prediction that the so-called "pure" sciences of today are fast becoming the applied [illegible]

[illegible]

GEOMORPHOLOGY

by Norman E. A. Hinds

Prentice-Hall Co., $5.00

GEOMORPHOLOGY is, as the name indicates, the study of the form of the earth, or more specifically, of the development of the surface relief of the earth. As such, it is the geologist's story of the origin of our landscape. To understand it one must know something of the rocks from which the landscape is formed, of the forces which build mountains and other surface features, and also of the agents of erosion which etch out the details of the world-wide picture.

Professor Hinds, a member of the faculty of the University of California, has presented here, in some detail, but in very readable style the essentials necessary to interpret the scenic picture, together with a multitude of specific examples illustrating the results of the inter-reaction of the various factors involved. The book is intended to serve as a textbook in the subject, but it should find a welcome place in the library of every lover of scenery as well as of every amateur geologist.

No branch of geology offers greater possibility for the use of beautiful photographic illustration; the more than 500 examples here, mostly chosen from the wealth of material offered within our own scenic country, add much to an already valuable work.

H. E. VOKES.

ORNAMENTAL AMERICAN SHRUBS

- - - - by William R. Van Dersal

Oxford University Press, $4.00

HERE is an excellent book by one who writes with authority based on exhaustive study and wide experience. As a biologist of the United States Department of Agriculture, Dr. Van Dersal has traveled throughout the country working on problems of using plants for soil conservation. On these trips he gathered much of the material for this book.

In the first chapter he sketches the fascinating story of early plant hunting in the United States; how the earliest plant explorers sent their beautiful new discoveries back to Europe, while the pioneers, who settled in America, imported most of their garden and orchard plants from England, France, Spain, Germany, and Italy. Finally it became evident that the best of the native American plants were, as a rule, better for America than the imported ones, for reasons explained by the author.

The map of the United States is divided into 32 plant growth regions. Reference to these makes it easy to answer the important question whether or not a shrub will thrive in a certain area. There is a chapter on "Where Shrubs Can Be Grown," and another on "How To Grow Shrubs."

Out of some 1300 shrubs in this country, Dr. Van Dersal describes in groups the best of these for all parts of the United States, telling us what the grower wishes to know. In summing up, he lists the ten best shrubs each for the Northeast, the Southeast, the Northwest, the Southwest, and California, as well as the ten best shrubs of the United States. The leading shrub in this final list is the Flame Azalea of the Appalachians. Nearly 90 exquisite photographs add to the attractiveness of a book that will be greatly appreciated by all who are interested in ornamental American shrubs.

CLYDE FISHER.

WILD ANIMALS OF THE ROCKIES

- - - - by William Marshall Rush

Harper & Brothers, $3.00

THIS book is a collection of stories about game animals, bear, elk, moose, deer, antelope, buffalo, mountain sheep, and mountain goat, and the experiences of the author during his 22 years as a ranger in the Forest Service. The stories are grouped by subject matter rather than in temporal sequence, and the amount of space devoted to each varies. Mr. Rush has a sincere love for the animals of which he writes and for the wild country in which he worked. Those who know the Rockies and share his affection for them will enjoy reading the book and may develop a touch of nostalgia from it.

Little new is added to the available information on the life histories of the mammals written about here, but some facts are probably unfamiliar to the reading public, for instance the diseases of bear, deer, and sheep, and the attempts to treat the sick animals in the National Parks. The stories are frequently humorous, some of the description is of high quality, and the action is often vigorous. At times there is a tendency toward crediting animals with foresight and intelligence a little too human, but a great deal of experience with coyotes and bears leads many people to that conclusion.

Quite as interesting as the animal stories are the accounts, often inferential, of the work of the rangers. As guardian of wild life and the forests, investigator of the causes of decrease of game, firefighter, and administrator of the grazing privileges, the author had a wide experience, which he shares with the reader.

J. F. AND H. L. HILL.

November **NATURAL HISTORY** 1942

Solomon Islands · Devil's Tower · Animals of Africa

Story of Textiles · Animal Superstitions · Quartz

VOLUME L, No. 4 FIFTY CENTS

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LETTERS

SIRS:

The September issue of NATURAL HISTORY is outstanding from a layout point of view—as usual—and was unusually interesting to me in the variety of its contents. I always study the layout of NATURAL HISTORY from cover to cover; you often have superb photos, but even when you don't, you do such interesting things with even the snapshots that the results look lively.

MARY LOUISE FAGG.

Washington, D. C.

SIRS:

As for NATURAL HISTORY, it is one of the best and most interesting magazines I know of dealing with the various phases of nature. I read each issue from cover to cover.

EVAN RANDOLPH.

Philadelphia, Pa.

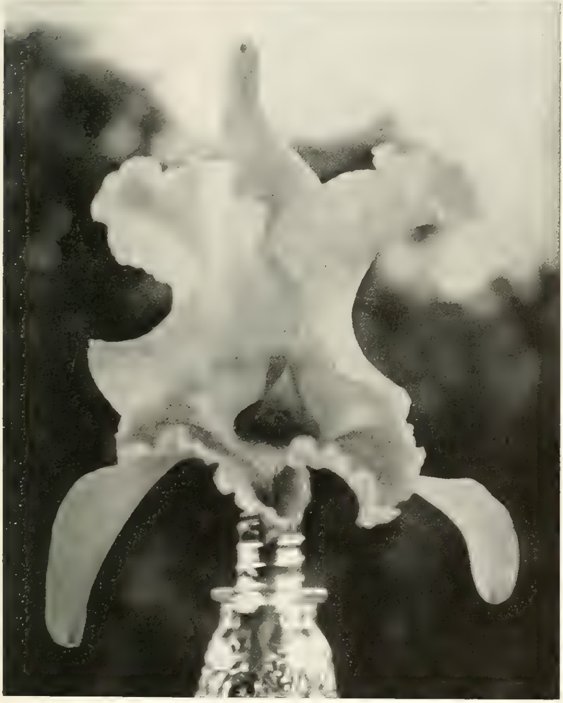
* * *

SIRS:

. . . Superb article on Drum Talk; only explanation on this subject I have ever seen that really explained it.

Dunedin, Fla.

M. D. FOLLIN.



A tiny cocker spaniel puppy looks out from the heart of this multicolored South American orchid

SIRS:

Your article in the June issue of NATURAL HISTORY on wild orchids has impelled me to submit the accompanying photograph for possible use on your "Letters" page.

The South American orchid *Cattleya labiata* is one of the showiest and most popular of the 40 or more species of *Cattleya* orchids indigenous to continental tropical America.

The blooms of this epiphytic orchid are multicolored, about six inches across, and spread a rich fragrance. The most interesting thing about these plants to me, however—as a lover of dogs—is the miniature cocker spaniel puppy that peeps from the throat of each bloom!

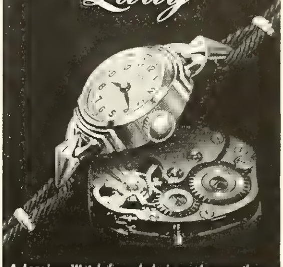
MAURICE BROUN.

Hawk Mountain Sanctuary,
Orwigsburg, Pa.

Continued on page 220

LONGINES

the most honored watch for a Lady



A Longines Watch for a lady is much more than a charming jewel-like ornament. Within the beautifully wrought case is the Longines "Observatory Movement*", a work of incredible precision, and unbelievable accuracy and dependability considering its tiny size. The photos of the Longines Watch and movement above are both greatly enlarged. The watch is one of several in the smart round design.

Longines

THE WORLD'S MOST HONORED WATCH

The established prestige of Longines Watches has resulted in a demand today greater than necessarily restricted production. Your Longines jeweler will show you the Longines Watches that are available, and all have the dependable Longines "Observatory Movement." Longines Watches have won ten world's fair grand prizes, 28 gold medals and more honors for accuracy than any other timepiece. See also the Wittnauer watch, a companion line outstanding for value at a moderate price—product of Longines-Wittnauer Watch Co., New York, Montreal, Geneva.*

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Albert E. Parr, Director

VOLUME L—No. 4 ★ ★ ★ ★ ★ ★ NOVEMBER, 1942

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From a Kodachrome by T. L. Bierwert, taken at the American Museum

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You will find Natural History Magazine indexed in *Reader's Guide to Periodical Literature* in your library

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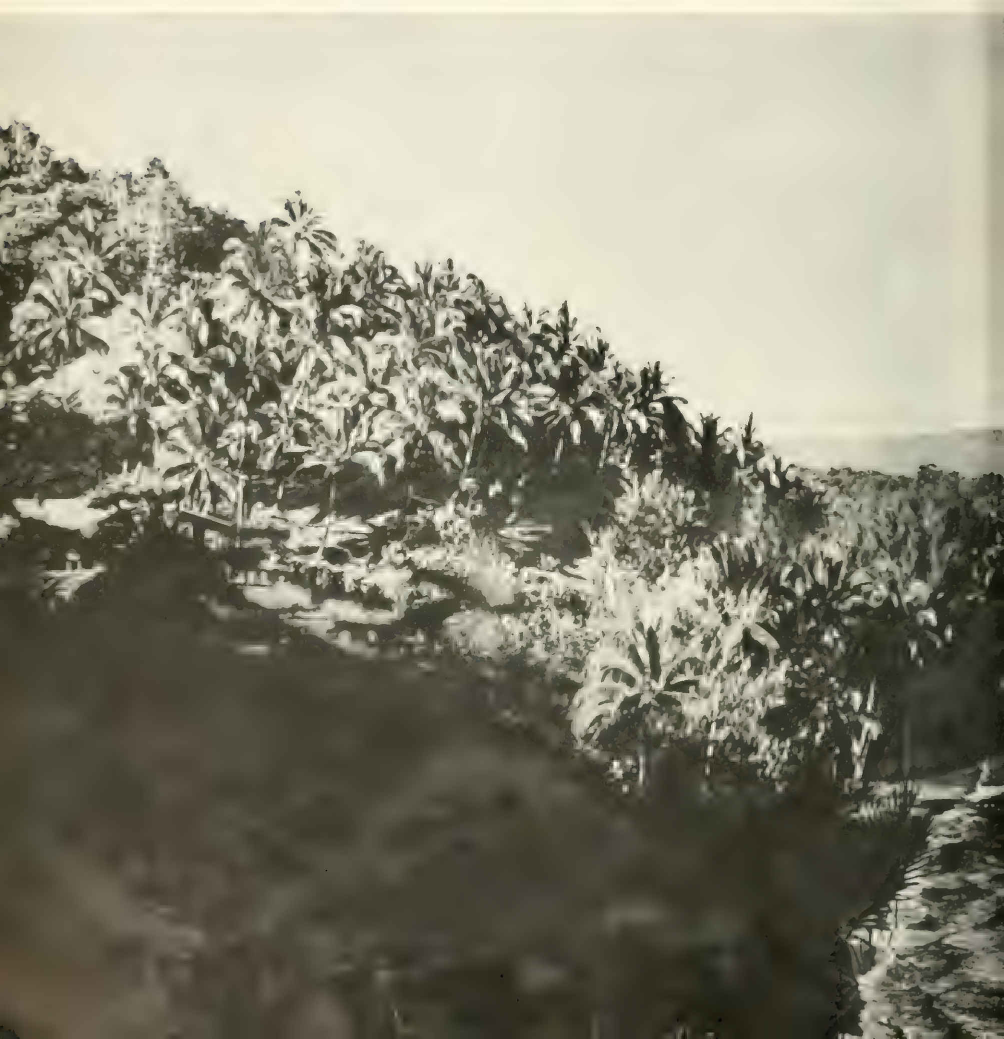
THE SOLOMON

By DOUGLAS L. OLIVER

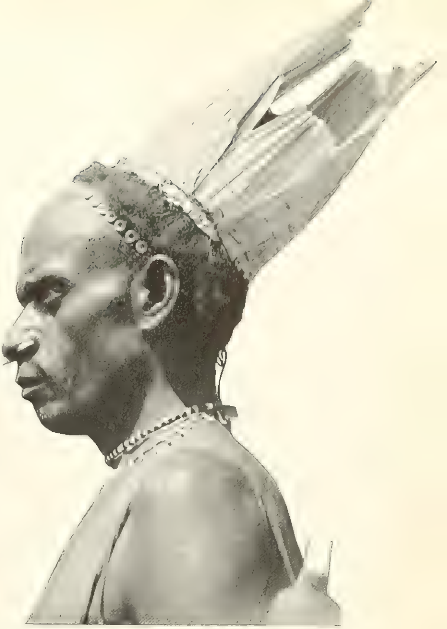
All photographs by the author, from Three Lions

▼ THE SOUTHERN COAST of the largest island in the Solomons, Bougainville. The bungalow at extreme left is the Government outpost for the whole southern part of the island. At this outpost, called Kangu, an Australian patrol officer was stationed, who kept the census records, collected the head tax, and heard court cases among the natives. A Roman Catholic Marist Mission was located near where the white launch is anchored. The missionaries used to travel about the interior making converts and administering to the health of the natives.



SLANDS

A sixteen-month expedition to the "Black Spot" of the South Pacific sheds light on a region now occupied by the Japanese



➤ A NOSE SKEWER and necklaces of clam shell disks and dogs' teeth are cherished ornaments of this Solomon Islander. His partly completed coconut leaf hat will be worn only on festive occasions. Trade-store buttons decorate his forehead

BECAUSE they are among the least known and most primitive people in the world, the Solomon Islanders are a dramatic illustration of the way in which the war has plunged obscure corners of the earth into sudden contact with the most elaborate developments of mechanized civilization. The accompanying photographs, taken in 1938 and 1939 during an anthropological investigation in Bougainville Island for the Peabody Museum of Harvard, show several important aspects of the primitive life of these people, little changed by civilization. Since then, many a bone-pointed spear has doubtless lodged in the back of a Japanese invader; and the purely native way of life may never again be seen here.

Bougainville, 125 miles long, is the largest island in the Solomon group and is mountainous, with marshy stretches along its outskirts. Lying northwest of Tulagi, Guadalcanal, and other points that have recently been the scene of violent fighting, it may be a main center of operations in the battle for the southwestern Pacific.

The Solomon Islands were named after King Solomon because of the natural riches they were believed to contain by the Spanish navigator Alvaro Mendaña, who is credited with their discovery in 1567. Indeed, because of this anticipated wealth, the Spaniards kept Mendaña's narrative a secret. Poor navigation and imperfect mapping contributed further to the delay, and it was two full centuries before the islands felt the impact of European contact. Actually the products of the islands are chiefly copra, tortoise shell, sandalwood, nuts, fruit, coffee, and cacao. But the natives, reckoning wealth in their own terms, attach more importance to the prestige gained through it than almost any other primitive people.

[illegible]
[illegible] social life.

[illegible] all [illegible] grim form of competitive generosity. The native will mobilize all his property and that of his family just to throw one big party at which he means to outdo his political rival. If the rival, in turn, wants to bid higher in the political race, he must invite his host to an even more sumptuous affair.

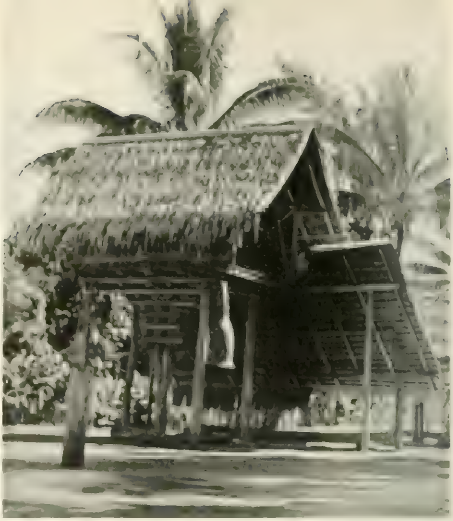
[illegible] all the ceremonies in the natives' lives. Weddings are [illegible] The Solomon Islands have not produced the worldly treasures that are associated with their Biblical namesake, but their inhabitants are thus found to have built up a social code that gives fantastic expression to the glory of wealth.

The name "Black Spot" has become attached to Bougainville and a few smaller islands in the Solomon group, because of the blackness of the natives as [illegible] New Guinea and elsewhere in the region. The negroids of Bougainville live a primitive agricultural life that is markedly different from that of most of the numerous oceanic peoples that are dispersed widely over [illegible] Austronesians. [illegible] Bougainville's own coastal strip, Austronesian people have encroached to become the "sophisticated" neighbors of these seclusive negroids.

On Bougainville there are some 30,000 natives. [illegible] their time mostly in smoking and chewing betel, while carrying on endless political discussions. The women raise crops of taro, Bougainville's staple food, as well as coconuts, almond, and breadfruit. The men also fish in the streams with bow and arrow, but they never [illegible] as fishermen or hunters.

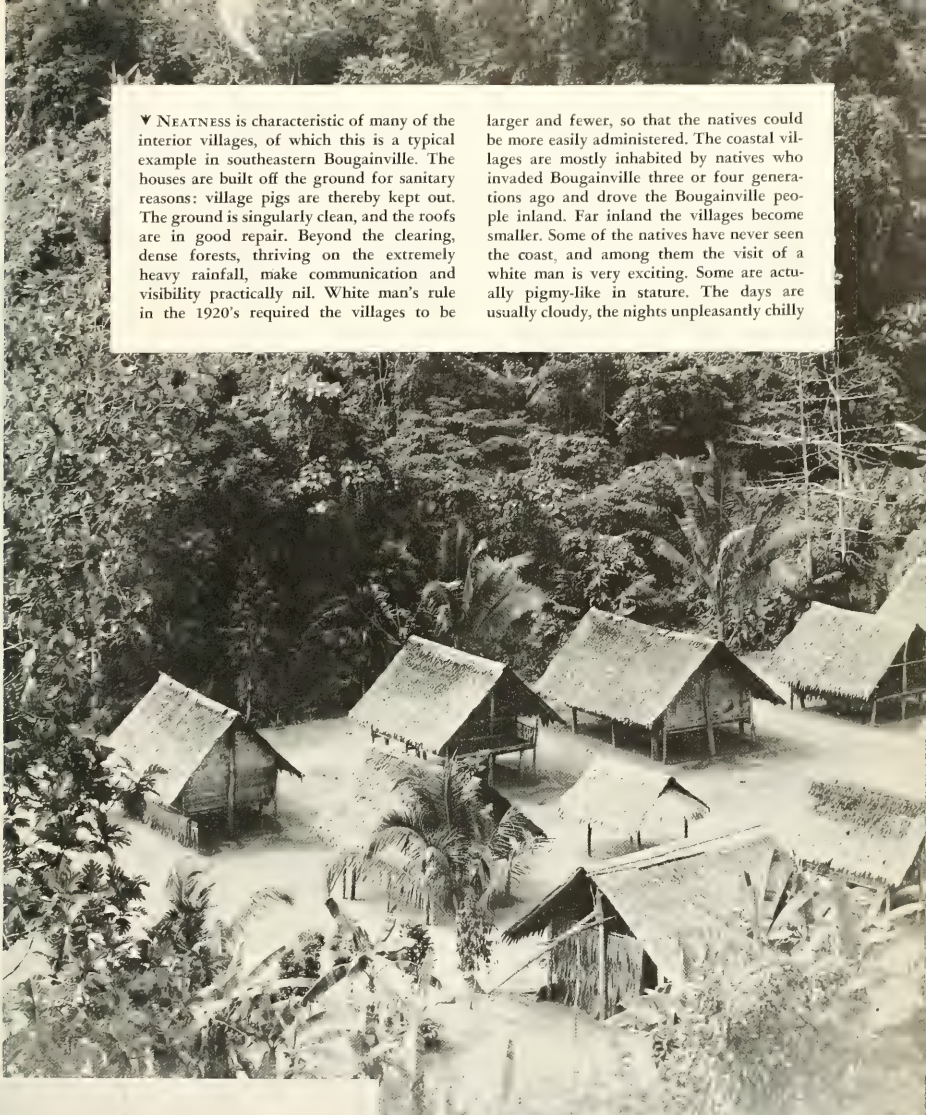
The history of the Solomons, from the time when traders and missionaries endeavored to settle in the [illegible] has not been peaceful. Murder and plunder have cast their shadow across the archipelago. About the middle of the last century Benjamin Boyd, while cruising in the yacht [illegible] and [illegible] demarcation between German and British influence in the islands was established. But the German Solomons, in which Bougainville was included, were occupied by an [illegible] the League of Nations. Even as late as 1927 an outbreak of the natives resulted in the death of several persons and necessitated martial law.

The plight of the Solomon Islanders at a focal [illegible] one. It is to be hoped that in the post-war world they will return to a more secure and constructive life than is now their lot.



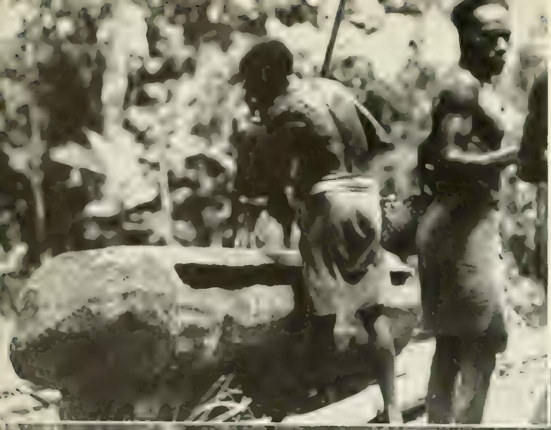
▲ TREE HOUSE in an inland village. Some houses of this type are actually built for protection against head hunters. Sleeping is done in the house itself, most of the cooking, eating, and gossiping under the adjacent shed. The basket-like object is a fish trap of a kind common throughout most of Melanesia

▼ **THE NATIVES have been required to keep their roads constantly improved to enable the officials to travel long distances on bicycles. Village chiefs, competing in the beautification of their road, sometimes widened them excessively, making highways broad enough for 40 men to walk abreast. Yet the natives themselves always walked down them single file**



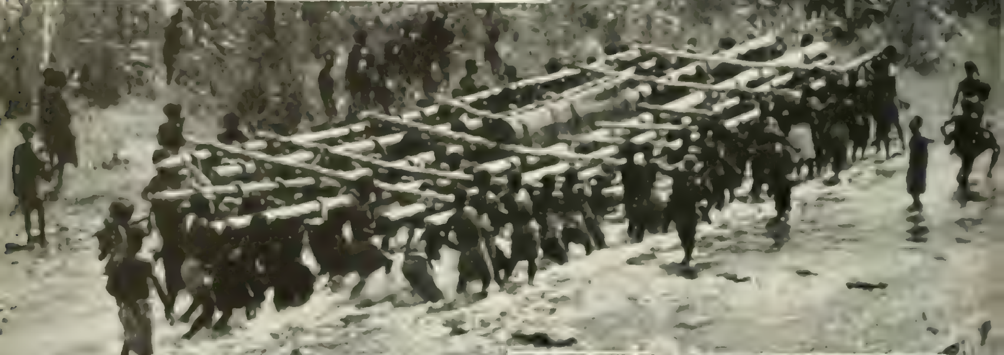
▼ NEATNESS is characteristic of many of the interior villages, of which this is a typical example in southeastern Bougainville. The houses are built off the ground for sanitary reasons: village pigs are thereby kept out. The ground is singularly clean, and the roofs are in good repair. Beyond the clearing, dense forests, thriving on the extremely heavy rainfall, make communication and visibility practically nil. White man's rule in the 1920's required the villages to be larger and fewer, so that the natives could be more easily administered. The coastal villages are mostly inhabited by natives who invaded Bougainville three or four generations ago and drove the Bougainville people inland. Far inland the villages become smaller. Some of the natives have never seen the coast, and among them the visit of a white man is very exciting. Some are actually pigmy-like in stature. The days are usually cloudy, the nights unpleasantly chilly

◀ AN OUTRIGGER DUGOUT in Kieta Harbor, the chief administrative and commercial center of Bougainville. Kieta Harbor can accommodate almost any size of ship and offers access to the interior by several mountain trails. Before the Japanese took over, it had a white population of about 30 and a small Chinese merchant population

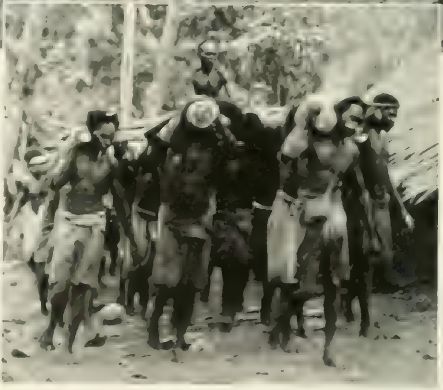


◄ A Passion for prestige goads every man to own as many wooden gongs as he can, for they indicate prosperity. The man who owns the most and whose gongs are most often beaten will be most widely known. The drums are installed in men's clubhouses, which women are forbidden to enter

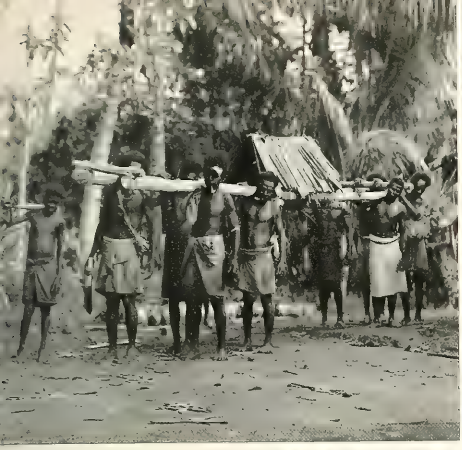
▼ The heavier the gong, the more men needed to carry it. The more men, the larger the outlay of food at the feast. The more food that is distributed, the greater will become the fame of the host. Therefore, it behooves the ambitious man to install as many large gongs as possible in his clubhouse

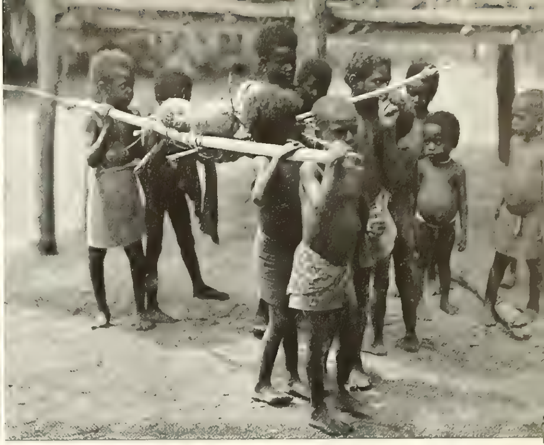


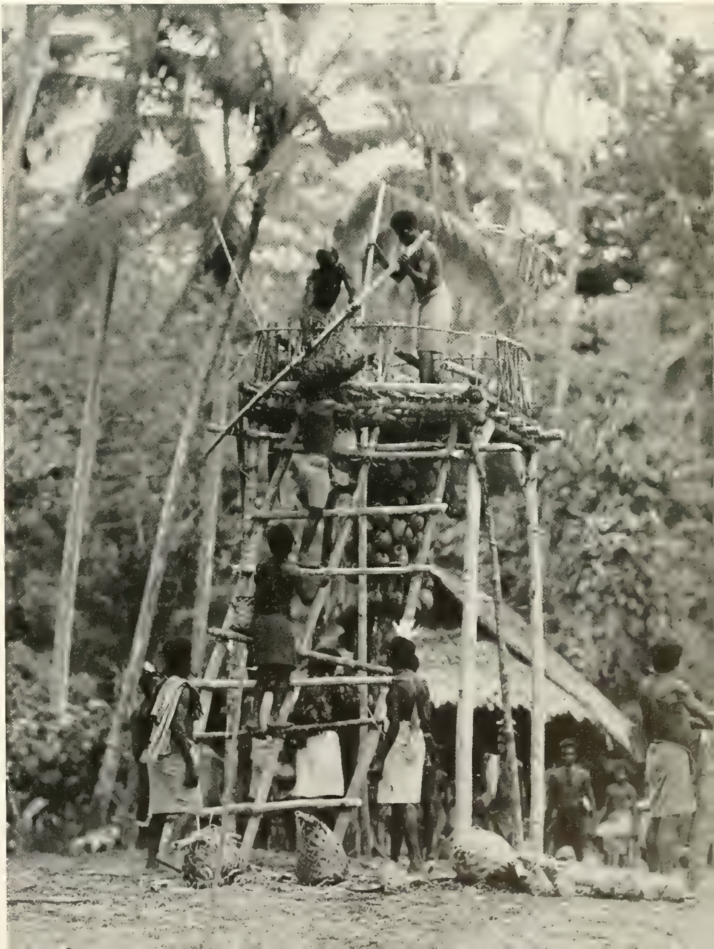
► Sometimes the owner will cause his invisible guardian demon to sit astride the gong to increase its weight and require the carriers to work harder. "What a heavy gong!" the people will then say. "What a wonderful man our host must be!" When the carriers become over-weary, however, they may place one of their own magicians on top of the gong, as shown here, to drive away the demon and lighten the load



◄ Shell money is the first necessity on the road to personal prestige in Bougainville's little known "Black Spot," but ownership of the money itself does not bring distinction. A man must distribute his wealth in the form of feasts. The natives themselves, however, do not make the shell necklaces and belts like those shown in this picture. They are manufactured of clam and mussel shells by coastal dwellers and are traded for pigs, weapons, and vegetables







▲ WITH THE ACCUMULATED SHELL MONEY the native buys pigs, so he can invite his rival to a generous feast that will show how opulent he is. The pigs in the village are not allowed to scavenge but are fed carefully cooked taro and yams. Here a large pig is being carried in from the forest to the village of the feast giver, protected from the sun under a palm leaf shelter

(Top, right) PLAYING GROWN-UP. So important among these people is the feast to gain prestige that even the children are imbued with the spirit and pretend to carry pigs to a feast as shown here

➤ AFTER ENOUGH pigs have been accumulated, the host constructs a display platform as shown at right and decorates it with food dainties —coconuts, taro puddings, etc. Anyone seeing so much food on display will naturally exclaim, "What a wealthy man he must be!"

▲ For days before the feast, the natives dance and sing in dress rehearsal, praising the virtues of their host. Then they dance toward his clubhouse, and the ceremony is on

▲ Flutes and pan pipes of all sizes and tones are played, but the most spectacular instrument is the large wooden trumpet being blown by the man in the center. It sounds not unlike a tuba. The total effect resembles a Brahms woodwind movement more than anything else in European music. Dancing can go on for eighteen hours without let-up

---

▼ In the final dance scene, the dancers circle the food display platform, which they will soon storm in an effort to get at the best tidbits

▼ After the feast the host distributes live pigs, one of which is seen here, amo the followers of the guest of honor. A careful record is kept of the number of pi The worried faces of the natives signify that they feel it may be no small task accumulate the equivalent for a reciprocal feast

▲ THE HEAD HUNTING DAYS are remembered by most of the natives, who use every opportunity to demonstrate their skill with spear, bow and arrow, and battle axe. Here a mimic battle is being staged

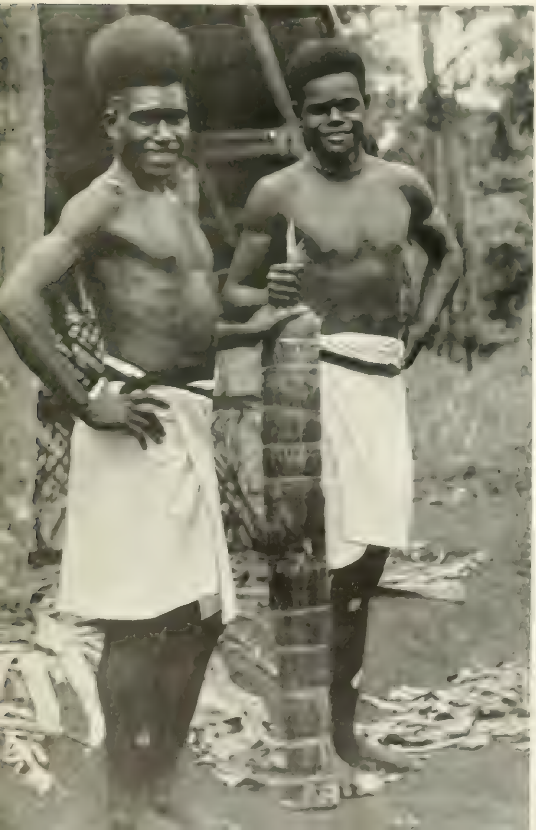
▲ HOSTILITY between host and guest is an undercurrent during the feast, for invitation is something of an insult, being a challenge to make a bigger display of generosity. Here the friends of the guest of honor, far from admitting complete deference, are staging a mock attack on the host's clubhouse

▼ A VERY OLD MAN grinding arica nut and lime, the familiar betel nut mixture which is chewed as a stimulant by all the natives

▼ A SOLOMON ISLAND YOUTH playing on a small flute of a type that is not native here but was copied from models from New Guinea

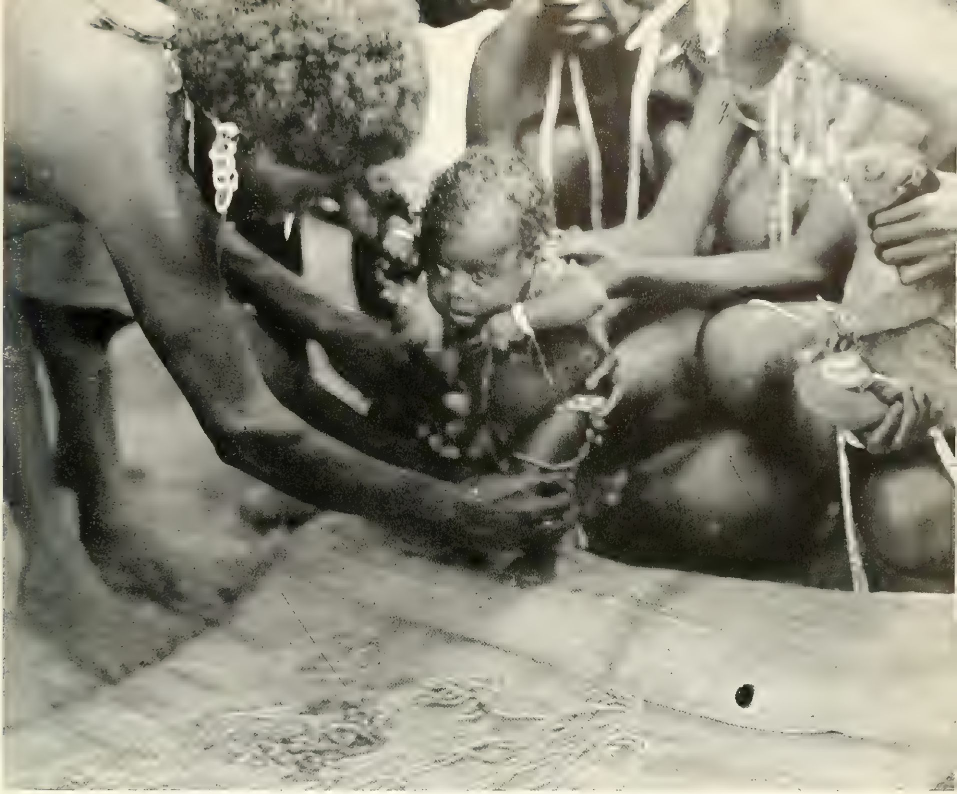
▲ THE TARO PLANT constitutes about 90% of the food consumed on Bougainville. This woman is planting the stalks in a hole made with a digging stick. The root tastes like a cross between an Irish potato and a turnip. The strong fence is to keep out hungry pigs

▲ AN INLAND WOMAN of the Solomon Islands weaving a basket of palm leaf fibers. These natives were still living in the stone age when first contacted by whites a few years ago



◄ SAGO, a dry granular starch, is prepared from the pith of the sago palm as a supplementary food. The pith is shredded with wooden mallets, and the starch separated from it by soaking. Sago settles to the bottom and is taken out and packed in leaf containers like the one shown here. The container is dried over a fire and packed away in the rafters for future use

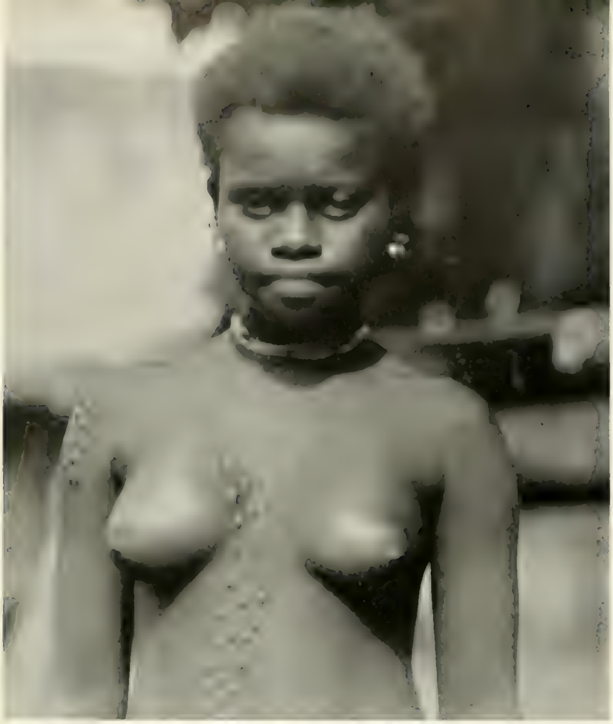
▼ FISHING WITH BOW-AND-ARROW AND SPEAR, after having diverted water from a stream by damming. The inlanders are primarily farmers and do not distinguish themselves as fishermen or hunters



▲ CHRISTENING CEREMONY. Coconut water is sprinkled over the child and a magic formula repeated imploring the ancestral spirits to make it strong and wealthy. Then the infant is made to walk over quantities of shell money and other valuables, as shown here. Both the infant and its mother are covered with shell necklaces, a sign of the wealth of the family. The opossum at right is a scapegoat which it is hoped the jealous and malicious spirits will mistake for the child in case they are inclined to vent any ill will. It is later sacrificed

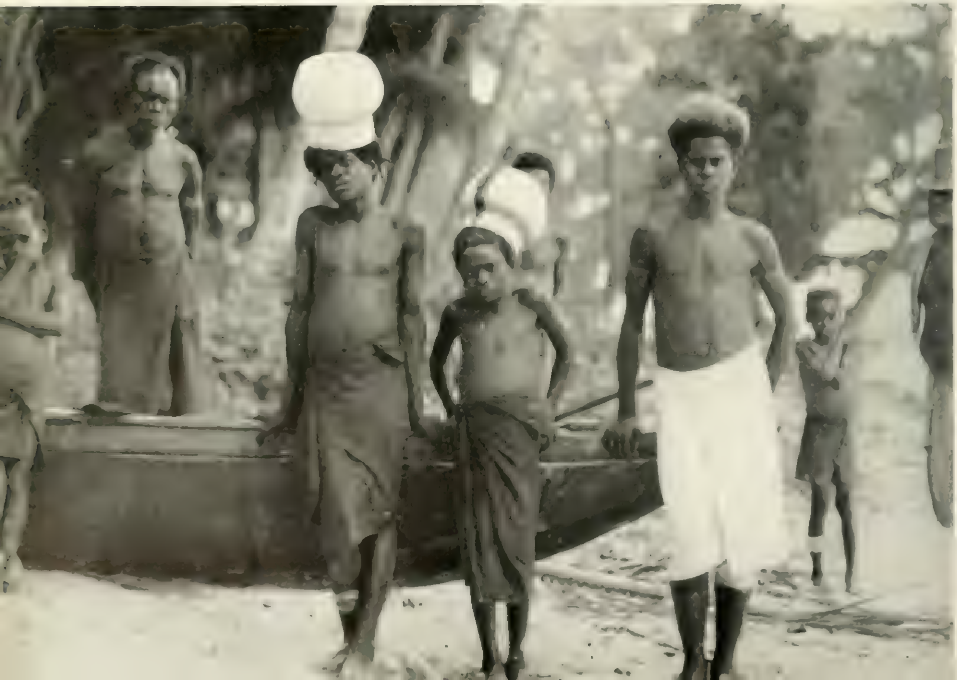
▼ A CHRISTENING CEREMONY is a good excuse for a dance, celebrated by the women alone. The calico that they wear here is from the traders; the short Mother Hubbards were furnished by missionaries. A few years ago the natives wore only a brief fiber apron and loin cloth

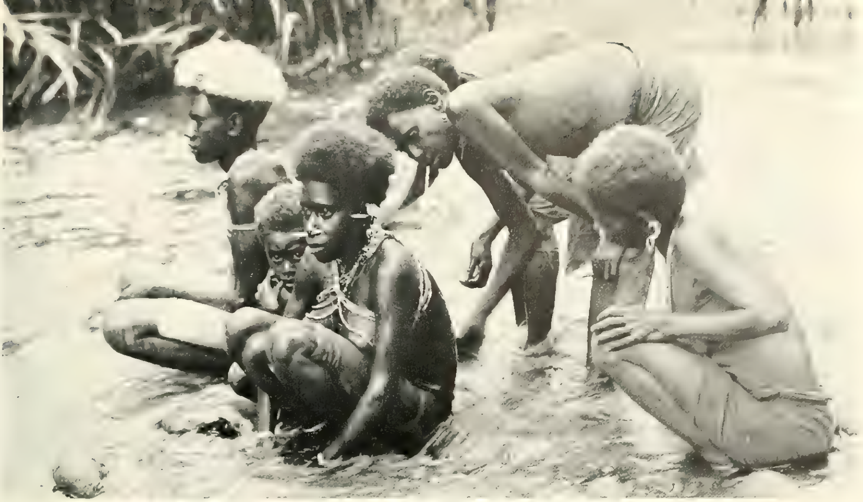
▼ YOUNG AND OLD show the energy of youth when there is a christening dance. The women have amazing vitality and work hard



◄ TATTOOING would not show on their dark skin, therefore the negroids of Bougainville produce scars by burning or cutting and rubbing dirt or ashes into the wound

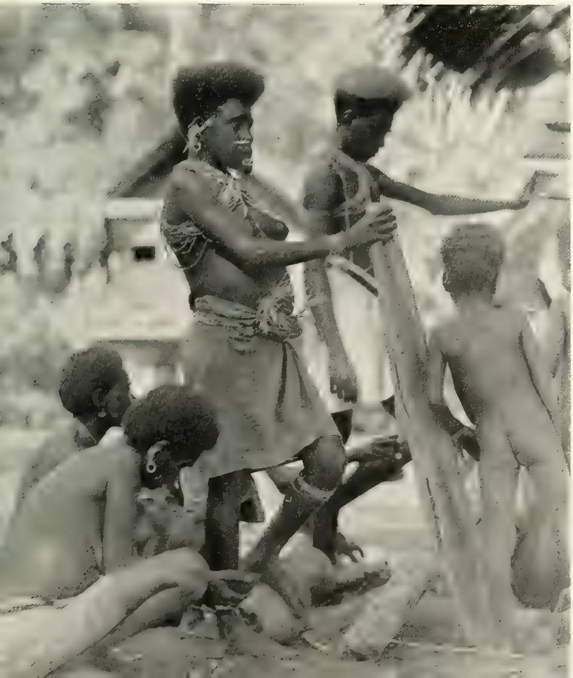
▼ ADOLESCENT BOYS wearing the hats they must never remove before women for several years. Any female who saw a youth without his hat would be instantly killed in the days before European control. The hair eventually fills the whole space. Then, when the father can afford a feast, the lad is initiated into the secret rites of full manhood and is considered mature. He can then set about finding a wife for himself





▲ Marriage ceremony. In the first episode, the groom (with "peroxided" hair) squats in a stream beside his bride, with a young bridesmaid in between. Three priestesses scoop water over the three, supplicating the ancestral spirits to give the young couple wealth and health. Enterprising Chinese traders have now begun to sell the natives real peroxide to replace the lime used in hair bleaching

▼ The bride and groom then stand by their house with one foot on a coconut, while priestesses anoint them with coconut oil in which magic ingredients have been placed. This, too, brings wealth and long life. Thereafter the young couple retire to the house and ritually eat a piece of pork. The marriage is thereby considered consecrated



▲ Lighting up. Women smoke even more continually than men among these inland people of the Solomons. Their pipes are bought from trade stores and almost never leave their mouths. Green leaves of tobacco are ripped from the home-grown plants, waved over a fire, and stuffed into the pipe. Sun-curing is rare, as indeed is the sun itself in the rainy mountains of the Solomons

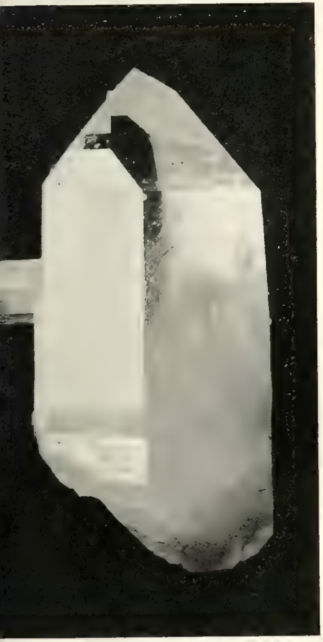
STRATEGIC MINERALS

NUMBER IX

QUARTZ

◄ A GLOBE OF CUT CRYSTAL calls attention to the one vital source, Brazil

AMNH photos by Coles



▲ QUARTZ crystallizes in the form of six-sided prisms, terminating in steeply inclined planes. These end planes do not have full symmetry but are grouped in two sets of three planes each, and their different nature must be considered in cutting quartz for use in radio

It is found almost everywhere and it enables man to defy space, but the pure crystals essential in *blitz* warfare all come from one country

By FREDERICK H. POUGH

Chairman and Acting Curator,
Geology and Mineralogy,
The American Museum of Natural History

Little drops of water
  Little grains of sand
Make the mighty ocean
  And the pleasant land.

ALTHOUGH the familiar rhyme isn't completely true, it does no serious violence to the scientist's feelings to say that little grains of sand make up the earth, and since most of the sand in the world is quartz, it is clear that quartz is one of the commonest of all minerals. It has been known to all peoples through all ages, under a multitude of names. For it has certain properties, obvious ones, which have made it a valuable material to all civilizations.

Its place on our strategic list, however, is not the result of any of its older uses. The modern use of quartz is totally new, and quartz is the only mineral that is strategic in this war but was of little importance in the last. A *blitzkrieg* would be literally impossible without it.

This is largely because of the use of quartz in radio instruments—a use discovered only 22 years ago. Today all radio sending sets, and some receivers, contain thin plates of quartz. These make it possible for many stations to operate simultaneously whereas only a few could before. When, for instance, you turn your radio dial to WOR, you always find it at 710, not wandering around somewhere between 700 and 720. The quartz crystal enables the sending station to stay precisely on its wave length or frequency, and thus many stations can be crowded into the air without overlapping. Today there are 900, as against 20 in 1922.

This sharp control of radio frequencies is vital in war actions, where many tanks, planes, and ships must remain in constant communication.

Chemically, quartz is one of the simplest minerals. It is silicon dioxide. By reason of its molecular structure, it is now classed with the silicates and thus belongs to a large group including about one-fourth of the known minerals. The silicate minerals are the principal rock-making minerals, and quartz is an important one of them. Since it is not always present in igneous rocks, it has been made one of the minerals upon which their subdivision is based.

The problem of locating strategic supplies of quartz is simplified by the fact that it is impossible for quartz to occur with certain other minerals. Where you find olivine, for instance, you will not find quartz, because olivine presupposes insufficient excess [illegible] volcanic activity occurred in the re- [illegible]

[illegible] metamorphic—, but it is originally an igneous mineral. It forms when deep- [illegible] pounds. We also get quartz if the still liquid portion of a crystallizing mag- [illegible] of silica which would otherwise have been used up in more complex combinations. This is the present theory [illegible] is the reason why some minerals cannot occur in the same rock with quartz.

[illegible] The stra- tegic variety of quartz is rock crystal, flawless, colorless, and of good size. [illegible] less for radio equipment.

Quartz crystallizes in six-sided prismatic crystals, terminated by six steeply inclined planes which are [illegible] These six terminal planes are not all alike, as in [illegible] sets of three planes each; hence quartz is said not to have full hexagonal sym- [illegible] called positive and negative rhombohedrons, and they are important in the radio use of quartz. In addition, quartz crystals sometimes have addi- [illegible] to the right or left of the ridge between the rhombohedrons, and these determine whether the crystal is what we call left-handed or right-handed. All quartz crystals are one or the other, or both in intergrown combinations, but their nature cannot easily be determined if this third series of faces is not present.

In modern times as in ancient, one of the characteristics of quartz that makes it useful is its hardness and, in the broader sense, its stability un- [illegible] ness is 7 on the mineral scale of hardnesses ranging from 1 to 10, and that is harder than the best grades of ordinary steel, which reach about 6. It does not cleave readily and is a tough mineral under impact. Quartz also resists acids: only hydrofluoric attacks it at an appreciable rate. It cannot oxidize since it is already a stable oxide; and since it does not combine readily with water, it survives the attacks of ordinary atmospheric weathering. The sands of our beaches are good evidence of the hardihood of this mineral, for they are the quartz that has remained in relatively pure form after the other ingredients of the rock have weathered away. The stable quartz fragments remain on the beach, while the feldspars and dark minerals composing the original granites have turned to clays and muds and been washed away into the sea.

One might think that so resistant and clear a mineral would make a [illegible] drawback—it is too common ever to be very valuable. There are many gem varieties: rock crystal, citrine, amethyst, and rose quartz, to name a few, and one could go on for half a page. In ancient times it was not realized that clear rock crystal quartz was the same as some of the opaque or translucent varieties like agate, chalcedony, carnelian, and jasper, for these were formed in a different way and look very dissimilar. Instead of being produced from the molten magma about which we spoke earlier, these were formed from aqueous solutions and are very finely, in fact microscopically, crystalline. Much of the silica composing them came from the decomposition of silicate minerals like feldspar, substances which appear to yield their silica into solution more readily than does the primary quartz.

The Greeks and Romans were, therefore, a little hazy about the true nature of some of their gems. They [illegible] *lus*, in allusion to their belief that it was formed in the Alps from water which was frozen so hard that it could never melt again. Since color was an important distinction to them, they naturally did not associate amethyst, crystal, agate, and jasper as we do today. The general name, quartz, was a miner's word in the Middle Ages, mentioned in Basil Valentine's and Agricola's works.

Large colorless and flawless single crystals are in great demand today for use in radio oscillators. The property of quartz that makes it valuable in electricity was investigated by the [illegible] *zin*, the Greek word for "to press"). This refers to the habit of the substance to develop an electrical charge upon application of pressure. Conversely, when subjected to alternating electrical current, quartz commences to vibrate, giving off current at the same time. The frequency of the vibration depends upon several factors: the orientation of the slice selected in the crystal and its proportions. However, for any single slice the frequency is very definite, never deviating from the fixed rate. Thus it can be used in a radio transmitter to fix the frequency of the vibrations and hence the wave length. Of course, the current generated by the single quartz slice is exceedingly small, but this is so amplified by oscillating vacuum tubes that the tiny fragile quartz is able to stabilize the frequency of the whole powerful transmitter.

Many other substances also exhibit this piezo-electric property—Rochelle salt, sugar, tourmaline, and others. Rochelle salt has a far stronger piezo-electric effect than quartz, and it is used in electric phonograph pickups. The vibrations of the needle cause the generation of an electric current in the Rochelle salt crystal. But this crystal is rather fragile and is sealed into a container in which it operates over a very limited range of temperature. Such pickups are far from sturdy, and radio transmitters in tanks and airplanes must stand considerable abuse and violent changes in temperature and humidity. Quartz is the only substance found so far which is satisfactory.

The cutting of these so-called "radio crystals" is a delicate job, for the frequency of the vibration will change with the removal of each molecular layer. Furthermore, in order to cut a slice that will retain a fixed frequency, it must be exactly oriented in the original crystal. Positive and negative rhombohedron faces must be identified, and the direction of the piezo-electric axes determined. An artificial face is then cut on the crystal at a definite angle to the Z-axis, an angle which must be within a quarter of a degree of the proper inclination. Slices of the flawless crystals are cut parallel to this layer, and they are then etched in hydrofluoric acid, which brings out a complex pattern if the crystal should be one of those complicated combinations of right- and left-handed crystals of which we spoke. If the slice, or a portion of it, is found to be usable, this is then shaped up to definite dimensions, and carefully ground smooth. The final slice is continually tested on an instrument which gives off a howl of varying tone as the slice is thinned down to the desired thickness and vibration frequency. When the instrument becomes silent, the crystal is ready. But so critical is the thickness that the brushing of a finger across the crystal can ruin it and start the howl again.

Several different cuts are used in making these crystals, either for different purposes or because of patents. Sometimes they are sliced singly, sometimes in groups by means of gang-saws. Again, a whole slab may be sliced in a single piece and later subdivided. But these small vibrating wafers are, of course, the final product. Vast quantities—millions—are needed. A single plane or tank may use a hundred or more to be in touch with other planes or tanks and with operational bases. With the vast number of mechanized units being produced today, it is not hard to visualize what a real problem it has become to get the necessary quartz and to turn it into the precisely made slices. In normal times only a few were needed, and a small cutter could turn out all that were required.

All of the quartz for these radio "crystals" comes from Brazil. It occurs in strongly weathered and decomposed veins which are related to the igneous activity in the region. The deposits are very ancient and probably were produced from solutions rich in silica which came off near the close of the magmatic activity. Some of the crystals are found still in place in the veins; others, having been washed down, lie in boulder beds.

The United States has agreed to buy all that Brazil produces, but even this may not be enough. Prices vary according to size and quality, from $1 or $2 per pound up to $15 or $30. Proportionally less is paid for crystals that are badly flawed or twinned (that is, composed of two or more crystals, or parts of crystals, in reverse position to each other) than for ones that permit easy orientation and the slicing of large, pure blocks of usable material.

Formerly much of Brazil's quartz went to Germany and Japan. Though most of this was of poor quality and was ostensibly imported for art carvings, much unquestionably leaked into war use. Today we are sure that none is getting to the Axis.

This country produces no quartz for electrical purposes, but there are thought to be possibilities in some of the Hot Springs, Arkansas, deposits; and the New York Herkimer County "diamonds" have even been considered. Sweden has recently reported deposits of good quality crystal, but little seems to be known about them. The American deposits will probably be exploited only if a serious Brazilian shortage develops, for the crystals are smaller and will be more expensive to slice. It is further hoped that experiments which are now being carried on may lead to the successful production of suitable synthetic material, but the task may prove a difficult one.

▼ Ground so precisely that the brush of a finger will ruin their radio frequency. Quartz "crystals" of this type make it possible for the many mechanized units in a modern battle to maintain contact with one another

RCA
QUARTZ CRYSTAL
CORPORATION
ERICA

AMNH photos by Coles

▼ An apparently flawless crystal section is shown by polarized light to be complexly twinned and hence worthless for radio. Quartz is also used in depth-sounding instruments, ballistic apparatus, periscopes, and gun sights

BIRTH
in the opossum family

By W. J. Hamilton, Jr.

The only animal in North America to raise its young in a pouch is spreading northward, to provide an interesting object of observation for the nature lover

PERHAPS none of our native mammals has excited more curiosity than the opossum, *Didelphis virginiana*. Its appearance alone is sufficient to arouse interest, and when we inquire into its mode of life, we find these most distinctive.

The opossum may be recognized by its long gray hairs, mixed with white and black, its white face, black and white naked ears, and long prehensile tail, which is quite devoid of fur. It is about the size of a house cat, varying in weight from three to seven pounds, although individuals often attain a greater weight.

In one form or another it is found throughout most of the United States, and in spite of persistent persecution by man, manages to maintain its numbers from year to year. Indeed, its numbers are even increasing, and reports during the past half century indicate that it is spreading into the north. In central and western New York the opossum was a curiosity 20 years ago, so much so that trappers, who took an occasional one in their skunk traps, were at a loss to know what manner of beast they had caught. For years it has ranked as an important game and furbearer in all of our southern states; soon, it appears that the opossum will play a like role in the north.

The opossum is no epicure. It feeds upon what is available, eating fruits and berries, worms, insects, snakes, small mammals and birds, carrion, garbage, and almost anything edible which happens in its path. From the stomach of one trapped near Ashville, North Carolina, I took a tiny box turtle, almost entire. It delights in the persimmon, feeding recklessly

◀ Nature's hitchhikers. **The lover of wildlife has a rare treat in store if he lies in wait to see the mother opossum's young clamber to her back, grasp her loose fur with their strong fingers and toes, and ride with her on her noctural journeys**

on the fallen fruit or climbing into the branches to gather the frost-tinted crop.

Through the long Indian Summer, the opossum has fed with abandon, increasing in weight and storing a substantial layer of fat for the inhospitable months ahead. With the advent of freezing weather, *Didelphis* becomes less active, sleeping through the day and part of the dark hours in a state bordering hibernation. But the opossum is not a true hibernator. Unlike the woodchuck, its temperature does not appreciably drop, nor is it loathe to venture forth when the pangs of hunger assert themselves. In the northeastern states, the tell-tale tracks of the opossum are often clearly marked on the new fallen snow.

My first glimpse of this peculiar beast was during the severe winter of 1919-20. The marshes and tidal flats near the site of the World's Fair at Flushing, New York, had frozen over during the cruel sub-zero weather, and the muskrats, which I had been trapping, moved into the higher ground. I had placed one of my traps in a burrow beneath a venerable willow tree in a cemetery, in the hope of catching one of these fur-bearers, for at that time their pelts were fetching fabulous prices. Imagine my surprise, on visiting my trap the following morning, to find an opossum in the trap. In spite of the arctic weather, it was very much alive, and showed no intention of playing "possum."

This matter of feigning death has made the opossum famous. Falling on its side, it lies quite motionless until shaken by the hunter or his mongrel cur. Then only will it utter a low hiss or grunt.

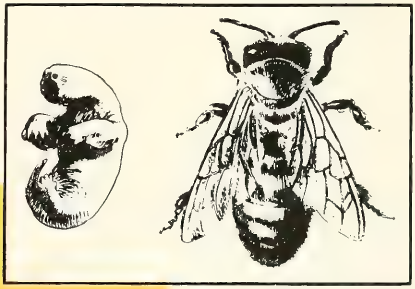
Countless myths have arisen in regard to the mode of reproduction, for the peculiar structure of the reproductive organs and the occurrence of the abortive young in the pouch have given rise to many superstitious notions. The breeding behavior and development of the young have been carefully studied by Professor Carl Hartman, and thanks to his long and minute observations, we now know the breeding habits of *Didelphis* as well as our other common mammals.

After mating, the embryonic young develop within the uterus for eleven to thirteen days. During this period they are not provided with the complete equipment for receiving nourishment from the mother that most other mammals have. But the membrane known as the chorion surrounding the embryo functions in this way instead of the more highly developed placenta.

This apparently is sufficient for the few days of life in the mother's body. At the end of this period, the young, appearing like living abortions, climb out and make their way "hand over hand" through a maze of hair to the opening of the pouch. Into this they crawl and grasp a nipple. So firmly do they become attached that it is well-nigh impossible to remove them. Some years ago, while collecting mammals in Costa Rica, I caught a large opossum whose pouch contained a squirming mass of young, perhaps an inch and a half long. Even by pulling forcefully I was unable to dislodge them from the teats and finally had to anesthetize the parent to remove one or two for specimens.

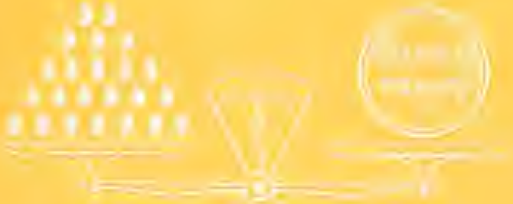
At birth the young are so small that it would take 23 to equal the weight of a penny. They remain in the haven of the pouch for two months, nourished only by their mother. They may number 16 to 20 at birth, though there are but thirteen teats in the pouch. Thus the last to arrive are doomed to starvation.

Continued on next page



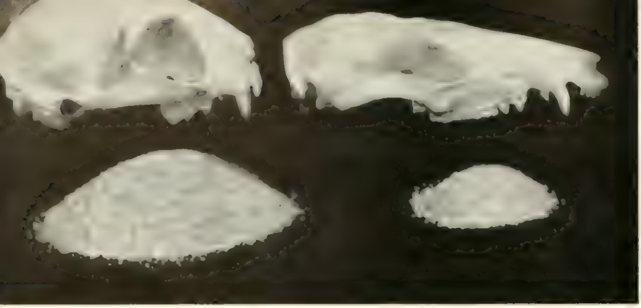
Drawing by Lloyd Sanford

▲ An adult opossum may weigh from three to seven pounds, but its offspring is smaller than a honey bee. The young are born in a most immature condition, but their fore limbs are relatively well formed. These enable the tiny creatures to climb hand over hand through a maze of hair to the pouch and firmly grasp a nipple



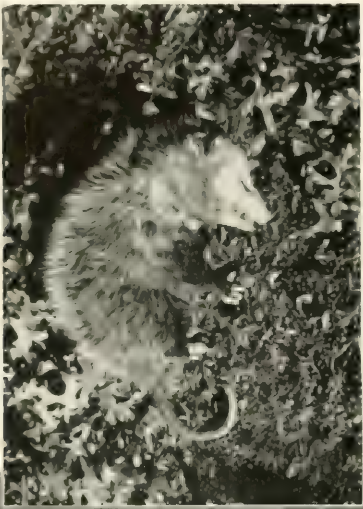
◀ It would take 23 young opossums to equal the weight of a penny

Drawing by Helen Babbitt



(*Above, right*) IN THE POUCH the two-day-old youngster shows little resemblance to the furry creature it will become

▲ THE OPOSSUM is about the size of a house cat, but it has only a little over one-fifth as much brain capacity. In spite of this small amount of "gray matter," the opossum is not only holding its own in North America but is actually extending its range



PLAYING 'POSSUM: an extraordinary photograph showing a live possum in the pose resembling death, for which it is famous. When confronted with danger, the opossum assumes this posture, exhibiting definite physiological changes which take place probably as a result of emotional shock. The habit may have saved the opossum from true death many times in the course of its long history. The Virginia opossum has changed little in size or structure during the past 70 million years

▼ A WHITE OPOSSUM: a biological sport, or deviation from type

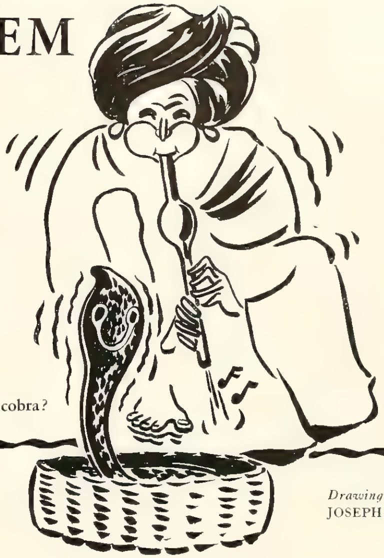
After this long "incubatory" period the young, now well furred and the size of large mice, commence to explore the outside world. They first clamber to the back of the mother, grasping her loose fur with their strong fingers and toes, and ride with her on her nocturnal journeys. Not until they are nearly three months old are they weaned. When they are the size of small rats, they leave their carriage, but remain together in loose-knit family ties for another month. In our northern states, probably a single litter is the rule, although the female is quite capable of producing two litters in a season.

The opossum is an important animal to the fur trade. It ranks about eighth in value to the trapper, not because of the price that the pelt fetches, but rather because of its enormous numbers. The animal is used in a number of ways. Large quantities were formerly exported to Europe, where the pelt was dyed to simulate skunk. In this country the better northern hides are made into jackets and coats, but the chief use is in trimmings for inexpensive garments. During times of affluence, the best pelts have brought as much as two dollars, but in recent years 30 to 50 cents has been the top. Indeed, some New Jersey trappers received more for the carcass during 1939 than they did for the pelt.

Its northern migration should bring delight to the hunters, trappers, and particularly nature lovers, for here we find a most adaptable creature, endowed both with economic importance and most unusual habits.

DO YOU BELIEVE THEM ?

Or do you think that some of the most startling and widely accepted beliefs about animals are pure fiction?



Does music charm the cobra?

By CLIFFORD B. MOORE

Director, Trailside Museum,
Springfield, Massachusetts

Drawings by
JOSEPH M. GUERRY

Snake charming

THE professional snake charmer with his stock of serpents (usually cobras), musical business, jugs, etc., is a familiar sight in many parts of the Orient, India, and even Egypt. Certainly the most mysterious element about the so-called snake charming is the apparent response of the snakes to music. This seems all the more mysterious since it has been conclusively proved that snakes are quite deaf and that the old adage, "deaf as an adder," holds true.

The reader has at some time seen pictures from India of cobras "dancing" to the music of snake charmers. On the other hand, those who have hunted snakes have observed that a basking serpent is not frightened away by talking, shouting, or other loud noises. In an effort to ascertain whether cobras actually can hear, Frank Wall covered the eyes of several individuals with adhesive tape and then proceeded to make various sounds near by. Both the blowing of a bugle and the beating of a large empty tin can close to their heads had no effect in arousing them. But on the other hand, if anyone walked along the floor near by or moved a chair, the snakes instantly reared up. This showed that the hearing was confined to and resulted from vibrations transmitted through solid objects in contact with the snakes. The reader can hear in the same manner the approach of a distant train by putting his ear to the steel rail.

The professional snake charmer is generally very careful to move his arms or legs incessantly or to sway his body back and forth while performing, and it is this rhythmic motion that "charms" the sensitive cobras and makes them appear to be dancing to the music.

The charmer's flute or other wood-wind instrument is played mainly to impress the observer, and it naturally has no power of inducing the cobra to come out of its jug into public view. The coming out is often induced in an unobtrusive way and appears as if in accompaniment to the music. It is actually done by the charmer's heavily and persistent thumping on the ground or the side of the jug with a switch, chain, or drumstick.

Hopper woppers

There is certainly a very widespread feeling that toads can remain alive for many years sealed up in blocks of cement or in rocks. This problem apparently perplexed our forefathers as far back as 1777, for at that time a French scientist, M. Herissant, went to work and proved beyond a doubt that a toad will survive for many months without food, but that when sealed up in masonry and thus deprived of fresh air, it immediately perishes.

Ditmars suggested a reasonable explanation for conserved toads. "Toads," he said, "are known to burrow deeply into the earth during a drought in search of damp ground. They return to the surface when infiltration tells them of returning rains. At such times they exist for months in a state bordering on suspended animation." It might follow that on breaking up a large chunk of dried and parched earth,

[illegible]

dug up alive and well. This species of toad has the habit of persistently digging into the earth. In desert and sandy regions of the Southwest it may remain in its burrow during the hottest part of the day to avoid being literally baked and evaporated by the scorching sun. In both of the cases referred to, the toads had retired into their burrows, pulling the earth or loose sand in around them. Apparently before the toads dug themselves out, infiltrating rain water and sunlight had virtually baked and made chunks out of the soil, fortunately leaving a few cracks, pores, or crevices through which fresh air reached the imprisoned toads. The people who first observed the two toads gave the opinion, in the presence of the author, that the creatures must have been sealed in for "many years."

Can a toad
live in a solid
piece of rock?

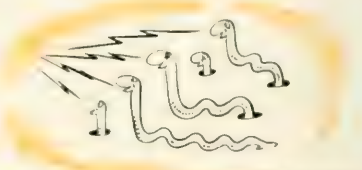
One spadefoot toad which received a good deal of publicity a few years ago and which was said to have been found "sealed in a concrete wall" was, on investigation by the author, revealed to have actually gotten into a crevice in a concrete cellar foundation —a cranny in the concrete which was formed by the falling out of a stone about the size of a baseball. Anyhow, it was a pretty snug fit, and when first disturbed, the toad puffed up its body, giving the impression that it was fairly well "sealed in."

Some such explanation can usually account for toads that appear to have been buried alive in concrete or rock. Actually we have no evidence indicating that it would be possible for a toad to survive for any considerable length of time in a block of stone or concrete.

Charming earthworms up out of the soil

Ever since man first went angling (and that was a long, long time ago), all manner of schemes and devices aiming to deceive and entice earthworms from their homes have been tried out and perfected. The fact that earthworms might come out of the ground at their own time regardless of all these strategies, was little considered by most of these over-enthusiastic and theoretical inventors. The result is that much time and money has been spent and a legion of gullible sportsmen have been "taken in," hook-line-and-sinker.

One of the methods in greatest vogue is the so-called vibrating of the ground. This is based on the assumption that when soil is agitated, the worms within it are disturbed and made to emerge from their burrows. An area of ground that bears evidence of the presence of earthworms (usually through their castings) is located, and the collector hammers or knocks against it to induce the worms to emerge. A variation is to drive a wooden stake into the ground to a depth of about one foot and to knock against the side of this until the worms appear.



Will an electric
charge bring earth-
worms to the surface?

Another method, described as "fiddling," employs a stake like that previously described, but instead of knocking against it, the operator rubs the side of a thin board across the top of the stake. This sets up a shuddering or vibratory action which, in turn, is thought to be transmitted for some distance.

It is well known to all who have studied the earthworm that its nervous development is of a most elementary sort. Upon the slightest disturbance from without, the worm will instinctively recoil or retreat more deeply within its burrow to safety. The reader who has tried to dig up earthworms with spade or garden fork will find an excellent illustration of this principle. Unless the worm is immediately pulled out

Other conceptions and misconceptions in the realm of natural history on which the reader may test his knowledge, appear at right. The answers are given on page 220

1. Will a circle of rope on the ground around you while sleeping protect you from rattlesnakes?

2. Are elephants deathly afraid of mice?

of its burrow upon being exposed, it will completely disappear from sight down the same burrow.

Controlled tests were conducted by the author using the "knock wood" and "fiddling" methods in different soil areas inhabited by large numbers of earthworms. These tests consistently and conclusively showed that instead of earthworms coming to the surface as claimed, the creatures sought refuge deeper in the soil. In every respect, our conclusions confirm those of W. R. Walton of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture.

Earthworms are able to distinguish between light and darkness and will retreat into their burrows from a sudden bright light, particularly when flashed on them at night. This fact should be taken into account by prospective anglers who go hunting for worms after dark with bright lights. A dim or diffused light may, however, give some success to those who prefer the flashlight to the spade. "The best light for the purpose," maintains Walton, "is a flashlight fitted with red glass, as red light does not frighten the worms."

Will discharges of electricity into the soil bring earthworms up? Some years ago, Prof. Robert M. Yerkes of Yale, proved with his "**T**-maze" that worms will retreat from the source of an electrical charge. The maze was set like a letter **T** so that the worm, after reaching the end of the straight path and then turning to the left, crawled over sandpaper and received an electrical shock. With repeated practice, involving some 50 trials, the worm learned to turn to the right and so escape from the tube.

Devices are now on the market which work on the theory that by receiving a charge of electricity through the surrounding soil, earthworms will rise to the surface. In actual practice and with some variation on the Yerkes experiment, we found that these devices instead of bringing the worms up, made them go deeper. Earthworms within eighteen inches of the two metal conducting rods worked down to a depth of one and one-half to two feet beneath the surface within ten minutes. But farther than eighteen inches from the poles, even a fairly high voltage became so diffused as to be virtually ineffectual.

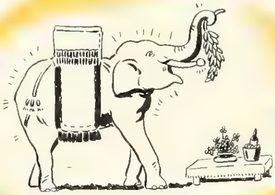
The correct inference to draw from all this is that there is nothing so effective in locating earthworms as some of that good old-fashioned foot power applied to the garden spade.

Is there such a thing as a white elephant?

Although elephants are never actually white, there are elephants whose skin is pale gray, with pinkish blotches. Far from being a burdensome possession as our phrase "white elephant" implies, however, these animals are greatly prized and even worshipped in Siam, and the captor of one is handsomely rewarded.

Years ago, a king of Siam had six white elephants at one time. Each resided in a palace of its own near the king's and had ten servants to tend its needs. The royal animals were fed on sugar cane, bananas wreathed with flowers, and fresh grass. Every afternoon dinner was served on spotless white tablecloths spread near a marble fountain in a shady court. The animals' tusks were ornamented with gold, and their heads covered with gold mesh. Small and exquisitely embroidered cushions were placed on their backs.

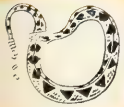
P. T. Barnum, who brought "Jumbo" to America, spent a fortune trying to obtain a white elephant for his circus. His representatives who journeyed to Siam were regarded with scorn after explaining their mission. However, one "white elephant" was bought from a lady of nobility whose dwindling fortunes made it no longer possible for her to keep her treasure in customary elegant white elephant style. The animal, sad to relate, died en route to America. Not to be discouraged Barnum later succeeded in bringing back to America a white elephant called "Toung Taloung." This animal received a star billing in the circus, but most people who beheld him were sadly disillusioned and disappointed to find he was not really white.



Is the white elephant an imaginary animal?

The expense involved in maintaining a white elephant which, save in a circus, has no value, was so heavy that the term "white elephant" became a common one to denote any impractical and costly possession or undertaking.

o snakes commit sui-
de by biting themselves?



4. Do elephants with waning strength
set out on a secret jungle trail for

5. Does the horned toad found in our Southwest squirt blood from its eyes?

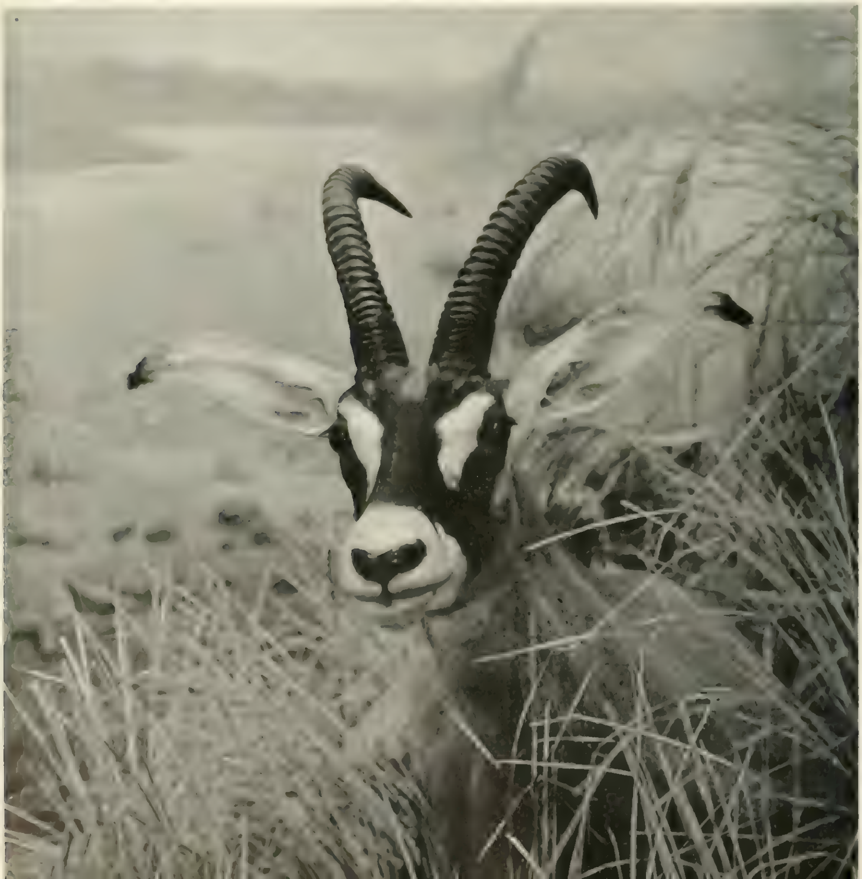
6. Do chameleons take th
color of different object

WILDLIFE
OF THE
UPPER NILE AND SUDAN

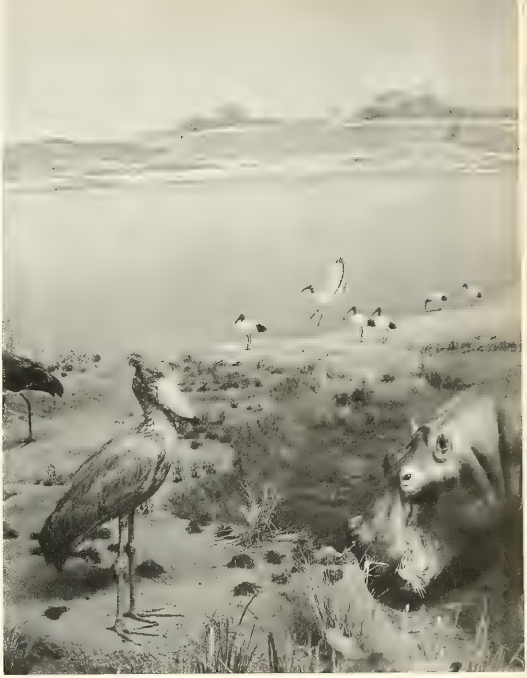
Animals far different from our own graze on the broad plains of Africa beneath the airplanes which crisscross daily in the conduct of the war.—Recent exhibits in Akeley African Hall at the American Museum

THE ROAN ANTELOPE (*Hippotragus equinus bakeri*) is easily distinguished by the prominent markings on its face and by its stout and comparatively short horns, curved like a scimitar. It is a light grizzled brown in color. It stands about 4 feet 9 inches at the shoulders and is one of the most graceful of the antelopes. Roan antelopes are found over a large part of Africa from the Sudan south to Rhodesia, and they usually travel in small bands of about five to fifteen

Photos by C. H. Coles and T. L. Bierwert



ALSO in the Upper Nile Group are displayed the fantastic shoebilled stork and the hippo, in a beautiful setting typical of their homeland. Despite the unwieldy and enormous bulk of the hippopotamus, often amounting to from two and a half to three tons, it is able to move with agility. Usually the disposition of the hippopotamus is mild, except when wounded or when its young are attacked, at which time it can ably defend itself. It is largely nocturnal, sleeping during the daytime in deep pools or basking in the sun, half-immersed in the water. So highly has the art of displaying animals been developed that the spectator standing in front of the exhibit can scarcely tell where the foreground merges into the painted background. He may have difficulty convincing himself that the birds at the water's edge are not mounted specimens



These groups were created under the direction of James L. Clark. The animals of the Upper Nile were mounted by G. Christensen and Louis Jonas, the foreground by Messrs. Petersen, Mason, and Freund, under the direction of Albert E. Butler. The background was painted by Messrs. Wilson and Kane, and the birds by Francis L. Jaques. The animals of the White Rhino Group were mounted by James L. Clark. The foreground of this group was done by Messrs. Petersen and Mason, under the direction of Albert E. Butler, and the background by J. Perry Wilson

THE WHITE RHINOCEROS, attaining a length of fifteen feet, is second in size only to the elephant among living land animals. Its formidable horns are neither tooth nor bone, but are compacted hair. Its eyesight is of limited service in detecting a possible enemy, but the nose and ears are acute. The white rhinoceros is much less prone to charge than is the black, which can at times become dangerously aggressive. Not actually white as the name might imply, this inhabitant of the Sudan is only slightly different in color from the darker gray of the so-called black rhino. The main difference is in the head and particularly in the muzzle, which is square rather than pointed

Right: A DESIGN from an old Peruvian cotton textile

WEAVING THROUGH THE AGES

By Estelle H. Ries

Making cord was one of Man's first arts, if not for clothing, for bow strings. Then came weaving, followed by the age-old traditions of the handicrafts and finally by industrialism with its complex tangle of synthetic fibers

WITH the wool shortage and the consequent loss of waistcoats, pleats, patch pockets, and trouser cuffs, scarcely any civilian industry [illegible] in the [illegible] textiles. However, the term is not restricted to clothing. Textiles confront us in every phase of home furnishing. We walk on them in the shape of rugs; our chairs and couches are upholstered with them; as draperies they ornament our windows, and in every room they are conspicuous in minor ways as well. Until recent years silk, wool, linen, and cotton were the sole materials for [illegible] articles. Now war and the [illegible] government priorities have accelerated the already rapid development of synthetic substitutes.

Indeed, the manufacture of textiles is a hallmark of civilization. Yet one of the earliest needs of primitive man was not for dress, but for cord. Whether he dressed or not, he needed fiber for a bow-cord, a sling, a net, or a snare, and other necessities so that he might overcome his dread of preying animals and obtain meat, fish, and other products. Making cord was one of his first arts (or hers, for it was usually woman's work), and cord was used for these other purposes long before man thought of weaving a fabric from the strand.

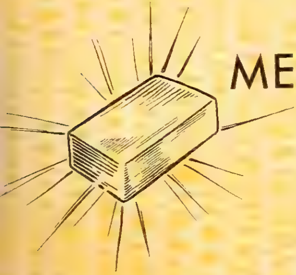
The spider weaving its silken threads, the birds interlacing grass and twigs into nests, gave early man a model and an inspiration. One historian suggests that a shepherd boy tending his flocks noticed a lock of wool which caught in a bramble, and upon twisting it found that the fibers would hold together. From such a beginning we may have evolved yarn.

Examples of weaving dating from the New Stone Age were revealed in 1853, about 4000 years after they were made, when a hot season lowered the level of Lake Zurich in Switzerland. In the mud were found relics of daily life in that prehistoric time. The fragments were of linen, black or brown, and showed a variety of designs and technique.

The best linen of ancient times came from Egypt and was in great demand over much of Asia. One of the most important officials in the Pharaoh's administration was the Director of the King's Flax. With only primitive looms at their disposal weavers achieved a remarkably fine fabric.

This was accomplished through skillful application of the laws of physics and chemistry, even if they were not identified as such. While chemistry is a young science, it is an ancient art. Ages before man

HAS WOVEN



METALS

FROM THE EARTH

BARK FROM

TREES

BASSWOOD

MILKWEED

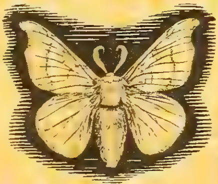
FIBERS FROM

PLANTS

FEATHERS FROM BIRDS

SILK FROM

INSECTS



WOOL AND HAIR FROM

ANIMALS

Drawings by HELEN BABBITT

had any knowledge of chemical formulas, he stumbled upon countless ways of putting chemistry to work. He found methods of saving time and hard labor by improving his materials and even creating new ones. Only within the last century and a half have we acquired a systematic scientific knowledge. But without any exact knowledge, our ancient forebears discovered how leather could be tanned, why linen could be bleached, or what happens when sand is fused into glass. Such old chemical secrets were discovered through a long series of accidents.

The linen bleachers of Thebes for ten centuries profited by a trade in linens that extended the whole length of the Mediterranean. What was their secret, handed down from father to son and practiced with such skill and patience? Before spreading the linen out in the sun, they treated it with a potent, magic powder prepared by the priests in the Temple of Ammon-Ra, and no doubt they attributed a large share of its success to the powerful god with the ram's head. A few of the shrewder of them may have suspected that their mysterious salts of Ammon were dried and powdered camel dung, but not one of them ever had an inkling that the efficacy of this remarkable preparation depended solely upon the ammonia in the manure—the ammonia that in a later millennium some chemist named for the old temple of Ammon-Ra.

Obviously the bleaching process had to be speeded up in modern times. Someone has calculated that there are not enough open green fields in the whole of the British Isles to provide "bleaching walks" ample enough to whiten the cloths of a single mill town. For all that, there are occasionally found little villages in Ireland, today's land of linen, where the natural outdoor bleaching methods are adhered to with special pride and where the harsher industrial methods are in disrepute.

Early spinning was done by holding a bunch of fibers under the left arm. Later this bunch was wound on a stick called a distaff, and since the performance of spinning was woman's work, the very word, distaff, has become a synonym for woman's authority or domain, or for women collectively. The woman who spins was called a spinster, and it is interesting to notice that she worked upon a single thread. The word wife, however, is related to weave, and she interlaced and unified the separate threads of a fabric even as she did the separate members of her family into a harmonious household.

In our everyday speech we show the high value put upon the arts of the loom, for do we not call a valuable thing which has come to us from the past an heirloom? Perhaps the most famous loom story is that of Penelope, the grass-widow of the long absent Ulysses. Several suitors paid her attentions, but she told them to wait until she might finish the work on her loom. Every night she unraveled what she had done during the day, showing that even in Homeric days, women could tell a good yarn as well as work with one.

However, the finest examples of ancient textiles come, not from the great centers of the Old World, but from Peru where the art had reached a very high stage of development before the coming of Pizzaro, the conqueror. Without any of our modern appli-

[illegible] Peruvian spinning not only surpassed the best machine spinning but contained the application of certain [illegible] strength and fitness of purpose, the ancient Peruvian [illegible]

[illegible]

[illegible] to man. Used in a primitive sling it enabled the savage hunter to perform previously unknown feats of marksmanship—propelling his missile straighter, farther, faster. Industrially or in the home it is the best of sewing threads. The gluttonous little producers of this miraculous fiber must be fed their mulberry [illegible] threads, which in turn are woven into a cocoon. From the cocoon, man extracts and prepares the silk used for weaving our loveliest textile creations.

Probably no other fabric gives such depth, fire, and brilliancy to color, or under other treatment, such dreamy opalescence. Had the Chinese had their way, perhaps none of us would know how silk is obtained. They kept the secret of its origin concealed from other countries for 2000 years by threatening to behead anyone disclosing it. They sold the beautiful completed product to the Persians, who in turn sold it to other nations of the civilized world without having the slightest idea as to how it was made or what it came from. But finally, legend has it, a Chinese princess, engaged to an Indian prince, could not bear the idea of replenishing her beautiful silken trousseau with cotton, which was the only fabric to be had in India. She hid some cocoons in her headdress when leaving her country, and thus silk was carried to the land of her spouse, whence it became known more widely throughout the Far and Near East. So great was its reputation for sheer delicacy that it was called "woven wind."

Another story has it that the silkworm was introduced from China to Europe by missionaries who carried the eggs in a hollow of their staff.

In the twelfth century, Roger the Norman, King of Sicily, made some conquests in the Eastern Empire, taking Corinth, Thebes, and Athens, and carrying off the silk-weavers to Palermo. He established them in a royal factory connected with his palace and compelled them to teach their art to his own craftsmen. [illegible] chief European source of the fabric down to the present time. King Henry IV of Navarre spent great sums developing silkworm-growing in France, and [illegible] her legs to silken hose. James I imported 10,000 mulberry trees to be sold at three farthings each in an effort to encourage silk cultivation in Great Britain. One of these trees enjoyed the distinction of being planted by William Shakespeare in Stratford and was later made into a chair for the great actor, Garrick. However, both climate and labor conditions doomed the experiment of silk cultivation to failure.

Textiles of silk, damask, and velvet reached their high point in the fifteenth century in Genoa, Florence, and Venice as well as in cities in Spain, and the greatest artists were willing to create designs for fabrics. Velvet, often called by its French name, velours, is a woven silk fabric having a short nap of erect loops, these loops being either cut or uncut. In the antique stuffs, areas were left uncut, forming a design against the cut pile. Brocade is woven silk stuff whose design may be only a difference of weave or may be of different color, further enriched by the use of superimposed gold and silver thread. Brocatelle is a heavy woven fabric of coarse texture, figured like brocade but usually made of wool and silk. The characteristics of silk in all its forms are softness, luster, luxuriousness, formality, courtliness, and conventionality, all of which were wonderfully adapted to the showy pageantry of the Renaissance.

"Vegetable lamb"

In earliest ages while our ancestors were still dressed in skins or wool, European travelers spoke of Asia as a wonderful land where wool grew upon trees in fleeces more beautiful than those of sheep. Vegetable lamb, the cotton plant was called.

Today the effect of cotton and its countless valuable by-products upon industry, commerce, finance, and politics is enormous. The need for manual workers adapted to work in the cotton fields was one of the principal reasons for the expansion of slavery, which led to the Civil War. Cotton has been a spur to England's colonial policy in Egypt, Australia, India, and elsewhere. The home spinning and weaving of cotton has been urged by Gandhi as a weapon in obtaining India's independence. Cotton is so important in our southern states that national politics must always reckon with it and often swing around it. During centuries of time, the infant's layette and the old man's shroud, and most of the textile needs between, have been provided by the cotton plant.

The use of cotton today far exceeds all other textiles combined.

The scene in the eighteenth century, however, differs strikingly from that of today. In England, textile industries employed not millions, but a few hundred thousand workers. They were often banded under a master for convenience and expediency, but spinning was really a home craft and could be done by the women at their own wheels. It was a long, slow process, and weavers were often idle because yarn-making could not keep up with them. The difficulty was aggravated in 1733 by John Kay's invention of the fly shuttle. This allowed one to throw the shuttle across mechanically instead of by hand, so that the speed of weaving was greatly increased, though the speed of spinning remained the same.

An invention named after a wife

In 1764, James Hargreaves, a poor, illiterate weaver, greatly relieved this situation by making a machine which spun eight yarns at a time as easily as one. His discovery was the result of an accident. His wife, Jenny, was spinning when the wheel happened to overturn. Hargreaves noticed that it kept on spinning just the same. This suggested to him that a number of spindles might stand upright and be spun all at once. He made a successful machine and named it a spinning jenny in honor of his wife.

Although Hargreaves was a plain workman, he was shrewd enough to keep his secret for his family's use. But the other spinners became suspicious of the great amount of yarn that came from the Hargreaves dwelling, and one day they mobbed his house and destroyed his machine. He had to flee to Nottingham where the jenny was ultimately appreciated.

However, it would not do everything, and another invention greatly advanced the industry. This was in 1769 when Richard Arkwright perfected a spinning frame in which the yarn was drawn out by a series of rollers, each pair revolving more rapidly than the one before.

These inventions were the forerunners of the Industrial Revolution in the Textile field. The laborer no longer owned the tools or machines with which he worked, nor had he anything to say about the product. Instead of managing his own time and life and doing a complete job from the getting of raw material to the finished product, he was placed in a factory that could hold the complex new machines and hired at a weekly wage. Sometimes he had but a single movement of the hand to repeat thousands of times a day. Huge sums of capital were brought together for running modern factories, and the corporation was developed as a suitable form of organization for this capital. Thousands of men were displaced by machines that could be run by a single boy or girl. At the same time, despite the confusion and suffering these changes entailed, the machines were a blessing to mankind as a whole, for they reduced the cost of necessities and made it possible for poor as well as rich to share in the good things of life. However, this possibility is but feebly realized. The problems brought about by the Industrial Revolution are still far from solved, and probably many changes of a fundamental character will be needed before our potential abundance can be enjoyed by all.

Cotton has always been more sought after for the brilliant dyes it held rather than for the beauty of the fabric itself, for compared to the fleecy softness of wool or the lustrous brilliance of silk, it is simple and unassuming. India was most successful in dyeing cotton. From its language we obtain the word chintz, which is derived from a Sanskrit word meaning spotted or bright. Cotton cloth was dyed many brilliant hues in Europe also. There it was called cretonne after the Normandy village of Creton, world famous for its weaving.

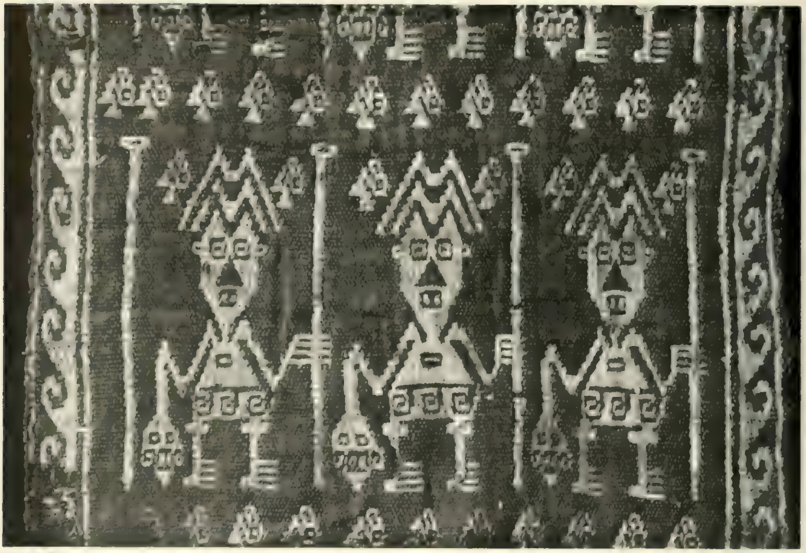
Colors in cloth

The chief beauty of textiles depends upon the color, and that in turn requires an art of dyeing. The art of coloring fabrics has been practiced from the most ancient days, almost since fabrics themselves were devised.

There are two types of dyestuffs: natural dyes, as old as the hills, and artificial or synthetic dyes, known for less than a century. The Egyptians, Indians, and Chinese early used rich colors obtained from plant and mineral sources, dyeing being a well developed art even then with limited facilities at hand. The ancient dyer was largely dependent on substances furnished by nature in a form ready for use. Natural vegetable dyes were obtained from leaves, stems, barks, roots, and fruits of plants and trees. Cochineal was derived from the dried bodies of red female insects. Indigo came from the fermentation of leaves and stems of the indigo herb.

Many of these dyes were rare, costly, and hard to work with. One had to be literally born to the purple, for only princes could pay $600 a pound for linen treated with a wonderful substance which was coaxed drop by drop from two tiny sacs possessed by a sea snail off the coast of Tyre. The dye was a thick, white liquid that smelled like garlic. Spread upon a cloth in the sun and air, it turned green, then blue, then purple. Wash the cloth with soap—that is, set it with alkali—and it became a fast cardinal red, still identified with the princes of the Church of

Woven from PLANTS



▲ COTTON. Some of the finest ancient textiles come from Peru, which produced the piece shown above, exhibited in the American Museum. This was woven from both sides of the loom, using two sets of warps and two of wefts. It has the same design or both faces but with solid masses reversed. The Peruvian Indians cultivated two shades of cotton: white and brown. Experts have stated that Peruvian spinning surpassed the best machine spinning and even employed certain principles unknown today

◀ FLAX. Time has weakened the Egypto-Arabic fabric at left but cannot obliterate the beauty of its design or the high art it represents. This cloth of flax from the early eleventh century bears tapestry-woven designs in colored silks and golden threads

▼ HEMP. The exotic textile below comes from the Philippine Islands. The dull red background of woven hemp is embroidered with blue and white beads and mother-of-pearl

Woven from METALS

Courtesy of the Newark Museum and the Museum of Costume Art

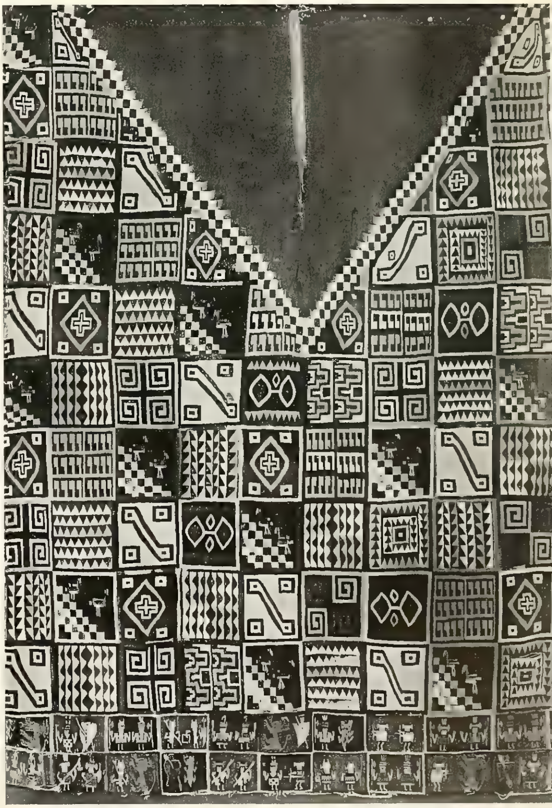
▲ GRASS. A rain coat from Korea, made of brown, closely-woven grass: an ingenious way in which man has used a common product of nature to meet the ever-recurrent problem of keeping dry in the rain

From Dykes' Genus Iris; *Courtesy of the New York Botanical Garden*

▲ IRIS. The Hupa and Yurok Indians of California made twine of fibers from the leaves of this flower *(Iris macrosiphon)*. The fibers were separated from the leaf by means of a clam shell

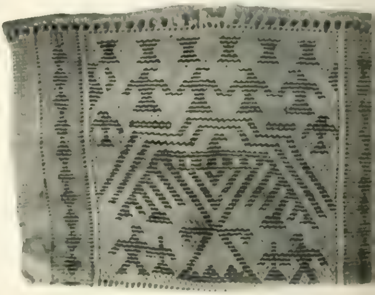
GOLD, copper, brass, iron, glass, and asbestos are among the mineral products which man has used for the weaving of textiles. Gold, long a symbol of wealth, was effectively woven in the damasks and brocades of the early Persians

SILVER tinsel yarn in considerable quantity is woven into the Bolivian poncho below. The yarn was spun in Peru by twisting a thin band or ribbon of silver about a finished yarn of cotton. Human figures embellish the two lowest rows of squares. The upper squares show geometrical designs, with occasional flying birds



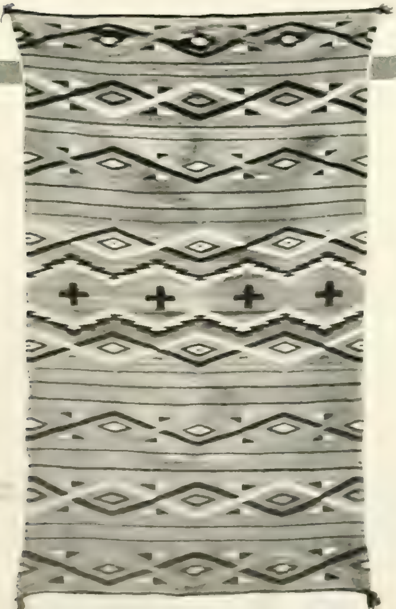
TREES

CEDAR bark is the material from which the Indians of the North Pacific coast made the headdress at left, and also capes. Even today some of our wool clothing contains a large amount of fiber from the bark of the redwood. Hill people of Madagascar made garments by weaving thread made from the inner bark of three different trees, then beating the fabric to soften it



BASSWOOD bark fiber forms the woven background of the old Menomini bag at right, from the region between Lake Superior and Lake Michigan. The design, showing the Thunderers, is worked in buffalo wool yarn

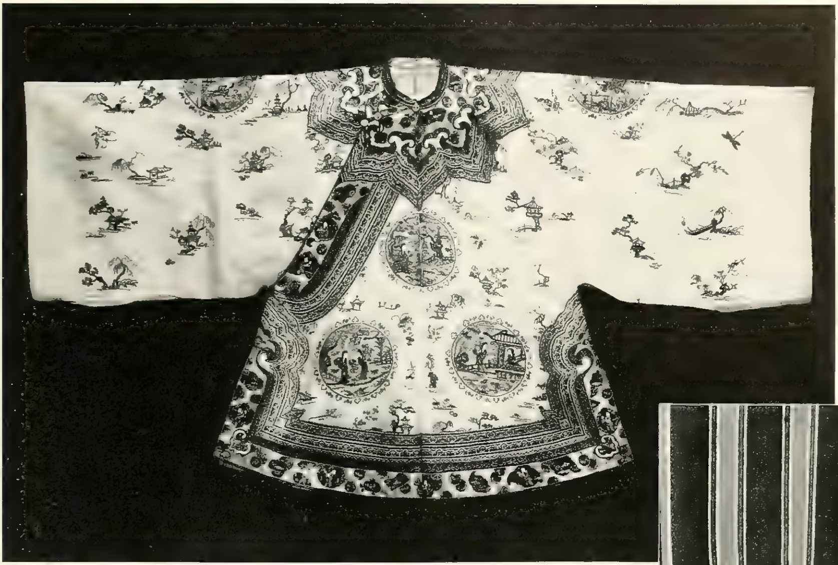
ANIMALS



WOOL from domestic sheep provides the material from which the Navajos weave their famous blankets, a fine example of which is shown at left. Though neighboring Indians raised cotton and wove blankets before sheep were introduced from Europe, the Navajos do not seem to have done so. The ancient Peruvians wove with wool from the camel-like alpaca, llama, guanaco, and vicuña. Wild goat wool was used by the Thompson Indians of the West Coast, also by the Chilcat Indians of Southeastern Alaska in weaving the characteristic Chilcat blanket

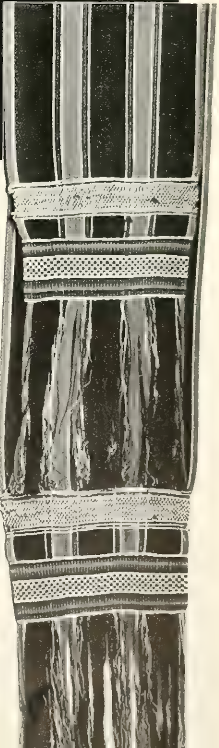
HAIR from the buffalo was used in weaving war bags and other things by the Osage Indians between the Missouri and Arkansas rivers. Belts and other small articles were woven from buffalo, bear, and moose hair by Indians in the eastern portions of the United States. An animal product used in weaving with which fewer persons are familiar is babiche—thread or thong made of sinew, gut, or rawhide. The Dené Indians of northwestern Canada wove light bags of babiche for carrying game

INSECTS AND BIRDS



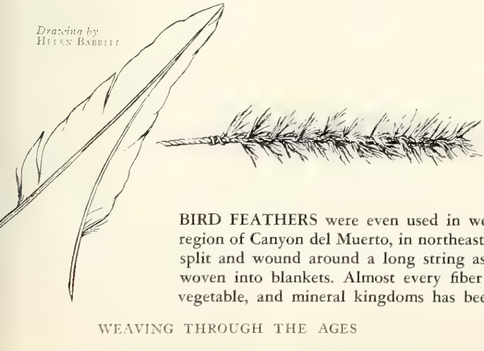
AMNH Photo

SILK perhaps excels every other fabric in depth, fire, and brilliance of color—qualities well exemplified by the gorgeous woman's jacket from Shanghai illustrated above, embellished with symbolic designs in gold and other colored thread. The history of silk has, over long periods of time, been well-nigh equivalent to the history of civilization in many parts of the world. Today, silk is a strategic material owing to its use in parachutes and in the manufacture of bags containing explosives which will not leave an incandescent ash after detonation in large guns. A recent newspaper article claims the development of new types of silkworms in Venezuela that will spin in 8 fast colors and 18 shades



WILD SILK was used by the Betsileo tribe of Madagascar in weaving the loin cloth, or *salaka,* at right. The natives gather the cocoons of the wild silkworms, of which there are about 20 species, in making this type of fabric

Courtesy of Ralph Linton and the Museum of Costume Art



Drawing by HELEN BABBITT

BIRD FEATHERS were even used in weaving by early Indians in the region of Canyon del Muerto, in northeastern Arizona. The feathers were split and wound around a long string as shown at left and were then woven into blankets. Almost every fiber or filament from the animal, vegetable, and mineral kingdoms has been used in the art of weaving [illegible] of the last century.

Aniline Dyes

In 1856, a seventeen-year-old English boy, William Henry Perkin was experimenting in a laboratory trying to find quinine. Instead of getting nice clear crystals from the mixture that he was making, he got from the chemicals a black sticky mass. When he went to wash this out with alcohol, he was surprised to see that it gave a beautiful purple solution. It was "mauve," the first of the aniline dyes. This started an industry which expanded the possibilities of beauty in the home far beyond expectation. The British Government gave Perkin a title, but though England led the world in textiles and needed more dyes than any other country, she gave him no support in his efforts to develop the possibilities to which he held the magic key. Perkin's instructor, Hofmann, a German, finally returned to Germany and practically took the infant industry there with him. Within a generation, Germany had the coal tar products business of the world in her hand. When war broke out in 1914, Britain with her billion-dollar textile industry, was crippled for the want of dyes, and in fact every country had to make new adjustments in the coal tar industry.

America now makes over 775 distinct coal tar dyes, from which it is possible to match any tint appropriate for coloring any material. Synthetic coloring materials are highly specialized. A dye suitable for wool cannot be used on cotton. One that is sunfast may not be waterproof. To match the exact shade in a straw hat, a rayon blouse, a homespun skirt, and a leather handbag may require 25 or 30 distinct dyes—a task that calls for the greatest skill of the dye manufacturer and the highest art of the color expert. While the manufacture of dyes is not a big business as we measure it in this country, American industries dependent upon dyes employ over two million men and women and produce over three billion dollars worth of products a year. Textiles use more than half the dyes.

Cotton, linen, silk, and wool are all dyed in different stages of their manufacture into cloth. They are dyed in the yarn, in the warp, and in the piece, or in the raw state before they are even spun. Some dyes are capable of coloring a material without the aid of any other substance, while others require an intermediate substance to fix or develop the color.

Now that color of any kind is so readily within call, we are devoting more attention to the quality of texture in fabrics, for texture harmony exists quite as surely as does harmony in color. Silk mellows light. Velvet adds warmth and richness. Where soft, rich color is desired, it is well to select velvet, whose silky luster makes deep shadows and high lights play in its folds. Numerous velvets are available, plain, striped, and of historic designs. Reproductions and inexpensive varieties may be had as well as those that more seriously tax the budget. When rich textures are employed, it is interesting to note that the color treatment may be much simpler than for coarser materials. Velvets, silks, and their derivatives are attractive even in one color, and a strong design detracts from the beauty of the surface finish. Plainer materials, such as cretonne, require bold color and considerable pattern, and these give to chintz the gay cheerfulness that makes it so charming.

Synthetic Fibers

We are fascinated today by the dazzling variety of new synthetic materials, for example fiber glass as beautiful as silk, yet rustproof, damp-proof, fireproof like glass itself. And there are shining cellophane, dull acetates, lacquered plastics, and non-tarnishing metals as well. Never before has the weaver possessed such rich and varied resources. Synthetic silks are now the word, and the worm that turned the world is threatened with being turned out. For more than 40 centuries, women have been thrilled as they dressed in the delicate, flimsy garments of this texture. Now it is being poured out by the millions of yards, not from the mouths of worms but the mouths of machines. For these 40 centuries, the worms have toiled for the few; now scientists of industry are working everywhere for the many—rich and poor alike. Here is the democratizing influence of a new industrial era. Such creatures of tradition are we, that for a long time we actually believed that the silk excreted by a worm was a more aristocratic substance than a similar fiber made in a clean test-tube out of pure elements. But that is perhaps a detail. Most important is the question, what of Japan? Before Pearl Harbor she annually sent us some 75 million pounds of silk, worth over $400,000,000 in good years. This used to be a restraining consideration of the first importance in her relations with the United States. In the years immediately preceding the war, we found a substitute for silk, but Japan has no substitute for those millions of dollars. With her income from silk, Japan paid for her imports of cotton, steel, and machinery. Having lost her American market she presses her treacherous attack ever more strenuously toward economic and political control of China and the Indies and possibly of Siberia as well.

But all is not gloom. For if militarism can be crushed and an equitable world economy established based on the Four Freedoms, Japan may well be able to resume her place in the family of nations on the strength of her silk production. Rayon, nylon, and other synthetic textile materials have outgrown their early connotation of artificial silk and no longer need to abolish the silk industry to assure their own success. On the contrary, synthetic textiles tend in some ways to strengthen rather than crowd out their companion fibers—silk, wool, and cotton. They have widened the use of each of these by the creation of new combinations of fabrics. Man-made fiber has a stabilizing effect on the entire textile industry. It is not subject to the whims of nature. Produced under human control there are no sudden fluctuations in supply or in price. Textiles are ready to rise harmoniously to the opportunities offered by an enlightened world policy. They wait only upon the world itself.

THE DEVIL'S TOWER

By H. E. VOKES

Associate Curator of Fossil Invertebrates, American Museum of Natural History

A strange history lies back of this "impossible" shaft of rock, which a local rancher resolved to climb at a Fourth of July picnic. Rising more than 1000 feet above the plains of northeastern Wyoming, its forbidding profile can be seen for approximately 100 miles

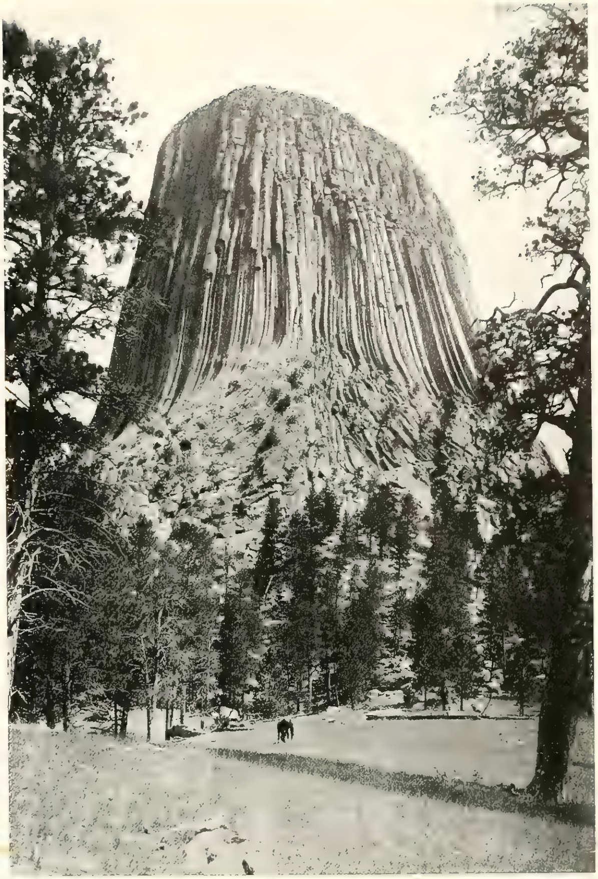


Photo by Albert Thomson

[illegible]

AMERICA's humorist, the late Will Rogers, would have had many chuckles over the predicament in which a namesake of his found himself on the Fourth of July, 1893. It all started when a big holiday celebration and picnic was planned in northeastern Wyoming, and the committee in charge of arrangements could not think of a headline event that would make it a red-letter occasion. Distances were great and settlements small in the Wild West before the days of the horseless carriage, and it was no easy job to get a crowd. Roping contests, the usual fare, were too commonplace; this year something unique was wanted.

One evening, so the story goes, after the committee had argued over many suggestions, the earlier Will Rogers, a local rancher, proposed in a jocular and reckless mood:

"Tell you what, boys, I'll climb the Devil's Tower for you. That ought to bring them."

They laughed at him.

"Neither you nor anyone else can climb that," they said.

Will felt challenged. "What'll you bet I can't? Is it worth your time to watch me try?"

Too late to back out

And so before the night was over, Will Rogers, being a man of his word and having a sizable bet to protect, found himself suddenly projected into the [illegible] W[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] Devil's Tower [illegible] unscalable. It is formed of great upright columns of [illegible] though they generally taper somewhat toward their tops. Near the summit they slope slightly inward, at [illegible] and ten to twelve on the east.

[illegible] ing the steep cliff would be a problem of a very different magnitude. In the lower quarter or third of the tower the columns tend to merge together to [illegible] the columnar structure. Will studied the problem with his associate and mapped out his plan of attack.

From far and wide

The Fourth of July dawned clear and bright, as July days do in that beautiful country. From all points of the compass people came on horseback, in [illegible] and [illegible] and even on foot. Some had been traveling for over a week. Will Rogers' projected ascent of the Devil's Tower was indeed a banner attraction. There was considerable speculation when he appeared carrying a large bundle of wooden pegs and a short-handled mallet. He also had a flag to be unfurled when he reached the top.

The climb began. Quickly surmounting the basal slope, Will selected a place at the foot of the cliff where the crack between two adjacent columns had not opened nor been greatly weathered. The purpose of his wooden pegs then became apparent to those who were watching: Will was going to build a ladder to the summit! It was slow work, driving in a peg, then inching up a little higher to put in another peg, and so on.

But little by little the tiny figure went higher, as the crowd, shocked into silence by the sheer audacity of the undertaking, strained their eyes to follow him. Will's form became smaller, until he looked no larger than a tiny ant climbing the side of a sugar barrel. From time to time he remained motionless, seeming to have reached the limit of his powers. "He'll never make it," said some; others, "Even if he gets up, he'll never be able to see his way back down."

And then he was crawling over the rim. To the accompaniment of great cheering from the gaping crowd below, Will Rogers stood up and unfolded [illegible] He [illegible] he had won his bet!

[illegible] the flag and carried it up into the air. It floated down almost into the very laps of the picnickers. Nor was enterprise lacking among them. Certain commercially minded individuals seized upon it and were soon selling small pieces as souvenirs of the greatest rock climb the W[illegible]

In legend on the sky

Meanwhile Rogers was exploring the summit before making the descent. He found himself on an almost flat surface, oval in outline and approximately one and one-half acres in extent. It was carpeted with grass, sagebrush, fern, and mosses. Most surprisingly too, he found that he was not the first to make the climb. Chipmunks had pioneered the undertaking and seemed to be flourishing there! How they succeeded in making the climb—and why they did it!—is still a mystery.

If the Devil's Tower looks high from below, it must have looked far higher to Will Rogers as he peered dizzily over the edge. The tremendous mass of rock beneath him has since been estimated to be sufficient for surfacing a sixteen-foot highway nine times around the world. However, he managed without mishap to descend the cliff and was greeted by the noisy acclaim of his wildly celebrating audience. Kegs were broached, and the glory of the feat grew in the telling. Then came the anti-climax.

Surrounded by his friends, swollen with pride and picnic beer, Will was startled to hear exultant shouts in the distance. Yoo-hoos and cat calls were drifting down from the upper regions. Picnickers round about him were saying the equivalent of, "Don't look now, Will, but somebody is on your tower." Will had done the supposedly impossible; had won his bet; had earned the plaudits of his audience. But now his feat had been duplicated by a group of boys! For while their parents had been congratulating their rancher neighbor, the youngsters had become bored and had set out to inspect his ladder. They had inspected it all the way to the summit!

And so it was a saddened Will Rogers who returned to his ranch home that night. His was still the glory of being the first to climb the tower—but that glory had been tarnished a bit by a few mere boys.

But it seems that Will may have recovered sufficiently from that discomfiture to boast about his climb a bit too often at home. At any rate, his humiliation was soon complete; for his wife went over to the tower one day and climbed it too!

In the years that have followed, perhaps 25 persons have climbed the tower. Will Rogers' ladder is now practically gone, and the last two parties to climb received permission to do so only after they had given assurance that they would not disturb any natural features, would use no artifical aids in their climb, and would receive no financial reward for the achievement. The climb is now prohibited because of the hazards involved.

Suddenly, just one year ago, the tower once more became the center of nationwide interest. Once again, its notoriety was the result of a foolish bet. A certain parachute jumper, whose actions do not justify the mention of his name, made a bet that he could jump from an airplane and land on the tower. He was not a mountain climber and apparently lacked even foresight enough to realize the problem he would face when he attempted to descend from the top. The jump was made; and he, too, won his bet. But for several days while he nursed his hunger on the top it appeared that he would not survive to collect his winnings. Finally, however, Dick Durrance and Harry Butterworth, experienced mountaineers who in September, 1938, had made the last recorded climb, voluntarily made the hazardous ascent a second time and succeeded in roping the parachutist down from his perch.

Just what is it about this great shaft that has attracted so much public interest and caused it to be singled out among our natural wonders as our first National Monument, in 1906, by President Theodore Roosevelt? Primarily it is its commanding position on the rolling plains in northeastern Wyoming. An old description says that it "resembles in appearance the stump of a great tree, its surface curiously striated vertically from top to base; and being perched on the crest of a high, flat-topped ridge, it becomes a very prominent landmark, which once seen, is so singular and unique that it can never be forgotten."

The story of its origin

To the student of earth history, the geological story of the shaft is as interesting and as singular as is the appearance of the tower itself. The principal evidence regarding its formation is to be found in the nature of the columns which so prominently mark it. They are composed of a microscopically crystalline type of granitic rock, the only rock of its type in the immediate vicinity. In the hills surrounding it, as well as in the banks of the Belle Fourche River, the exposed formations consist of almost flat-lying beds of bright-colored sandstones. The tower seems to be resting upon them, and they in turn seem to sag downward beneath its weight. Since these sandstones underlie at least a portion of the tower, it is obvious that the molten mass which solidified to form the shaft reached its present position after the sandstones were laid down. And yet, if these sandstones had formed the surface rock at the time, the molten material, working its way up through them, would have poured out on the surface as lava and would, under normal conditions, have cooled too quickly to permit the formation of the columns which characterize the monument. It is, in fact, the size of these which indicates that there was originally a considerable thickness of sedimentary rock lying above what is now the present surface, and that the tower was not forced up into the air in its present condition, but was formed beneath the surface and later exposed.

On a basis of the evidence, the following geologic history of the landmark is offered:

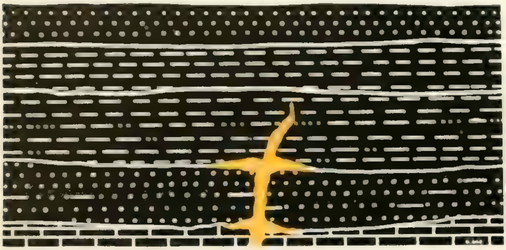
From 40 to 60 million years ago, a mass of molten rock was forced up through the mantle of sandstone, probably along the somewhat pipelike vent. Urged on by the pressure below, it worked its way up through the rock, layer by layer, until at last it came to a layer which resisted its advances so strongly that the molten material was forced to spread out sideways. The strong layer was pushed up into a dome-shaped eminence, and the molten material or magma as the geologists call it, did not succeed in breaking through.

Vertical columns formed in cooling

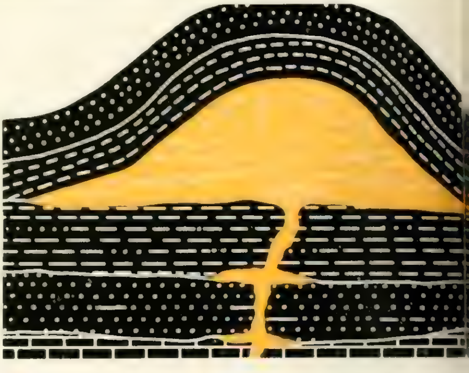
The upper layers of rock acted as a blanket, under which the dome-shaped mass of magma cooled rather slowly into a finely crystallized, granitelike rock. And during its cooling, it contracted and cracked into great columns. The cracks that formed these columns developed much as the cracks do that appear in drying mud, which tend to radiate out at angles of about 120 degrees from one another in a honey-comb pattern. In the cooling mass of rock, the centers of contraction were not all equally far apart, so that the resulting columns are not all six-sided but range all the way from three- to eight-sided.

Columns of this type always form at right angles to the cooling surface, in other words, at right angles to the broadest surface area. Since the columns of Devil's Tower are almost vertical, the greatest extent of the mass of which it is a remnant was therefore horizontal. The columns were formed mostly in the central portion of the mass, because the top and bottom portions, being in closer contact with the cool surrounding rock, lost their heat too quickly to develop columns.

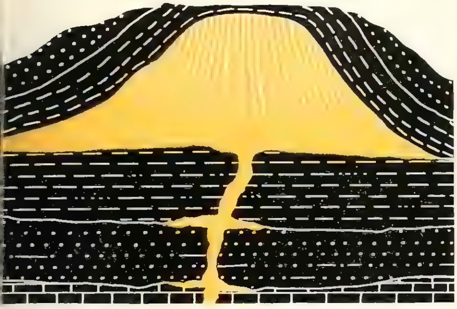
All during this process, the slow but inexorable forces of erosion—rain, heat, cold, wind, etc.—tore at the overlying mantle. At last they succeeded in doing what the pressure behind the magma itself had



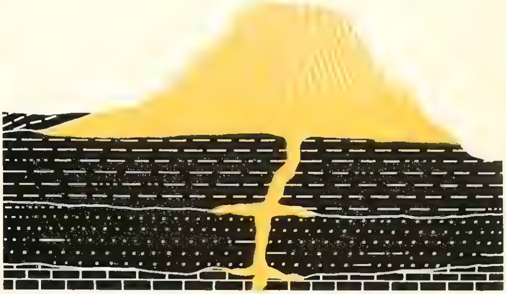
1 HOW IT WAS FORMED: Some 40 to 60 million years ago a mass of molten material ate its way up through the mantle of sedimentary rock, as shown above



2 MEETING a stronger layer, the molten material had sufficient pressure to bulge it upward but could not break through and therefore spread sideways



The Mass slowly cooled and contracted, cracking into vertical columns near the center. Meanwhile, the elements were wearing away the surface mantle



Drawings by Victor McIntosh

In time the mass was exposed, and its sides were in turn eroded by the elements. The harder columnar core has resisted erosion and remains today

United States Department of the Interior Photo

As a result we have the slender, towering shaft of Devil's Tower, the last remnant of a once much larger body of igneous rock

▼ **The Little Missouri Buttes.** These neighboring lacoliths are of the same rock as the Tower, but lacking its prominent columnar jointing, they have been eroded as rounded hills

Photo by Albert Thomson

[illegible] there remained only a towering central remnant, the tall slender shaft that is our impressive scenic monument [illegible] setting for W. O. Rogers' triumph and discomfiture just 40 years ago.

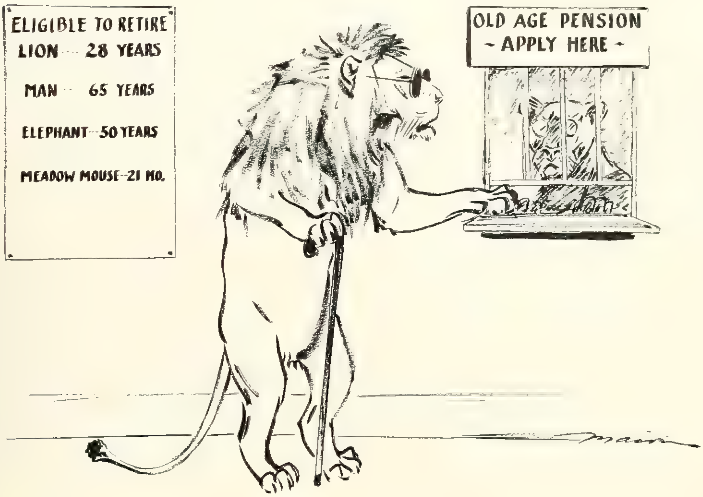
▸ The Indians explained the striations on the sides of the tower as the claw marks left by a gigantic bear which tried to catch a maiden who had escaped to the top

[illegible]

An airplane view shows the surface of the tower—an acre and a half of land seen at close range by but few persons. A mystery still remains as to how chipmunks living there reached the summit—or why they chose to make it their home

[illegible]

OLD AGE IN MAMMALS



By JOHN ERIC HILL

Drawn by

G. FREDERICK MASON

IN the wild very few mammals reach old age. If they are meat eaters, like the lion, a little reduction in the keenness of the senses or the loss of a little vigor or speed, often means that the predator can no longer catch his prey. If the aging carnivore turns to eating carrion, he must compete with a number of "professional" scavengers, and even this way of life may be hard. Many old lions are killed and eaten by the hyaenas. A plant-eater likewise is much more likely to fall victim to a hungry carnivore when age begins to stiffen joints and dull the warning senses than when he is young and vigorous. There is little provision for old age in nature.

This theoretical picture is often confirmed when we collect animals in the wild. Few individuals are secured that are older than young adults, comparable to a man of 25, especially among the small species and the predators.

But although among most mammals this is true, monkeys, apes, and bears often reach a ripe old age, as shown by worn teeth and closed growth-lines (sutures), particularly between the bones of the skull. They may indeed live longer in their native haunts than in captivity. Both bears and monkeys have the ability to eat many kinds of food, so they are not handicapped in this respect by age as are the predators, and they do not have many enemies. Although monkeys may be old, they are not likely to be more than 20 years of age, while an old bear may be 30.

Of all the mammals, man is the one with the longest potential life-span, but few men reach the age of 65 except under conditions of civilization and in temperate climates, however contrary that may be to legend. In the cartoon the lion is shown to be at 28 about equivalent in age to a man of 65. Few lions in captivity reach that age, and it is unlikely that any do under natural conditions.

For many years it was thought that the elephants were very long-lived. Natives and travelers told of elephants hundreds of years old, but when actual records were kept the oldest one that could be found was about 60, and very few were 50. But even if the elephant can no longer be given first place in age, he may properly be accorded the second.

Whales were long the subjects of much speculation. Some thought they must live a very long time to reach such a large size. All of the studies in recent years, however, show that only twelve years is required for the largest whale to grow up, and none were found much older than that.

Small rodents are among the shortest lived mammals. Our common meadow mouse rarely lives more than 21 months, almost invariably dying in the second winter of its life. The small, sharp-nosed shrews live only about the same time, finding the age of more than a year too great a handicap in winter.

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Programs of the American Museum and Hayden Planetarium, Fall, 1942.

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Exploring Space. Science in the sky

THIS PREOCCUPIED FLORIDA CRANE closely resembles the sand hill cranes that are becoming more numerous in regions to the north

(From an American Museum group photographed by C. H. Coles)

THE FLYING CROSS

By GRACE V. SHARRITT

Wise conservation laws and a sympathetic public are rescuing a magnificent bird from near extinction

WHEN winds are high and rains flood the muddy bottomlands, the sand-hill crane appears upon the spring and fall horizons. Flying with head extended and drooping legs through the blue October sky, he has gained for himself the name of Flying Cross. His only herald is a weird, trumpet-like call, echoed when he sights his resting ground. Smoky-colored and standing almost as tall as man, he makes an odd appearance, for his plumage is so distributed that he appears to be wearing a feathered Victorian bustle and a brief red skull-cap.

The sand-hill crane in the past has been a fast diminishing race, but owing to state and federal laws of conservation and a wide-awake public, the bird is slowly increasing its numbers. It is within the past five or six years that this increase in the crane census has begun to assume favorable proportions. From scattered areas throughout the land, isolated reports identifying the bird have come in to state conservation departments and federal reservations.

There was the farmer who told how he was shocking corn in a southern Michigan farm when he saw a flock of six greyish-tan birds walking slowly along the fence of his cornfield. He had never seen anything like them in the 20 years he had been plowing his farm. He stood in silence as long as he could, watching the grotesque looking birds feed on the dropped corn. Then excitedly he called to his son across the road, "Come here, John. Hurry! There's the dangest looking ostriches." At the sound of his voice, however, the cranes lifted their huge bodies from the ground and formed their flying crosses against the sky. Not one person out of 50 or 100, it has been estimated, has ever seen a sand-hill crane in the wild, yet here was a Michigan farmer within speaking distance of a flock of birds so rare that he didn't know their names.

On a spring morning, a fisherman was surprised

Photo by Bernard W. Baker

▲ **As they appear when rising to form flying crosses against the sky: sand-hill cranes wintering in a rice field near Houston, Texas**

to see a sand-hill crane feeding on roots or crustaceans in the mud of the bank. He knew it to be a sand-hill crane, for as he wrote in *Outdoor Indiana* (the official publication of the Indiana State Conservation Department): "All my kid life I'd heard my mother talk about sand-hill cranes. To me they was something that jest never would be seen agin. They was goners with the Kankakee marshes and the old beech woods when the trees got water and nourishment enough to make beechnuts for me . . . sand-hill cranes was gone with the wild pigeons . . . with the deer and panthers."

The life-story of the sand-hill crane has a pattern similar to that of many of the pioneer American game and non-game birds, moving from one of overabundance almost to one of extinction. Formerly the crane bred from British Columbia, Saskatchewan, and southwestern Michigan south to California, Nebraska, and Ohio, and in migration east to New England.

It is now rare east of the Mississippi; its southern range is practically erased. It still breeds from northeastern California, Texas, and Louisiana, south to Mexico. Laxness in game law enforcement (cranes are excellent to eat), and the draining of the marshlands throughout the Midwest, are the main forces working against the crane.

The marshlands are positively essential to the propagation of the bird. The cranes do not tend to have large families—in fact, they just about manage to carry on their strain. The female bird lays two greenish-brown eggs in a nest made from grasses, weeds, roots, and mud. The crane is well able to protect itself. It will avoid man, but when cornered, is extremely wary. When, by the 1930's, the cattail marshes and muddy flats of duck weeds and swamp grasses of the Midwest were destroyed to make way for the widening of steel mill districts across the prairies of Illinois, northwestern Indiana, and parts of Ohio and Michigan, the birds moved farther and farther into the remote swamps and regions of northern Michigan, Canada, Minnesota, and the Dakotas. The crane needed encouragement to increase, instead of destruction of its nesting ground. Fortunately the government stepped in to help preserve the bird.

Each autumn as their tribe grew alarmingly smaller, Mom Crane, on the day of their take-off from the North to the South might well have said to Dad in *Grus canadensis* language. "Well, Sandy, do you think we can make it to Texas? The hunters are better shots each season."

"Yep," the old man might have answered, rolling a weather eye to the sky. "The boys do seem to aim surer. But cheer up, maybe the game wardens will help us through."

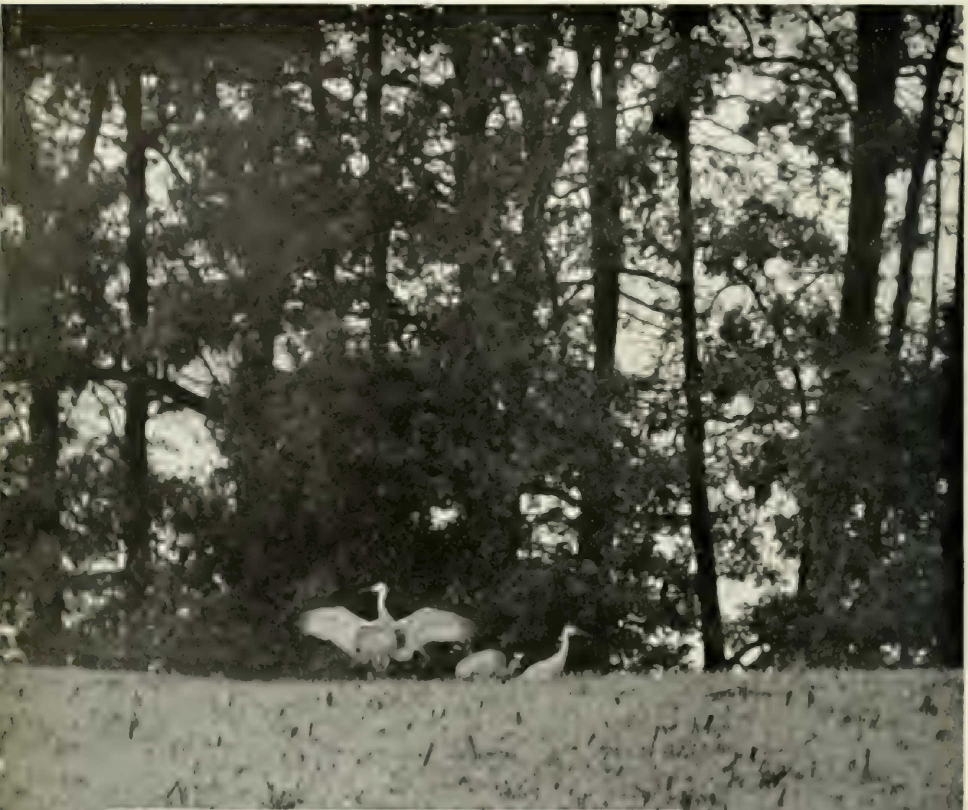
The state and federal game wardens, coupled with a greater public interest, have increased the life-line of these cranes, which are cousins to the Florida little brown cranes. Marshlands are coming back in some areas, and where this miracle occurs through established reservations or legislation, more frequent reports of the appearance of the crane come in. These Flying Crosses are among the highest flying of all birds. Many an aviator has been thrilled with their cross formation a mile above the earth.

Out in the Red River Valley in the last two years, Flying Crosses have been observed in numbers from 500 to 600, winging south in the fall. The amazed

[illegible]

[illegible] them. At least that theory holds true in Michigan. [illegible] watching the rare, cautious cranes that tarry to rest [illegible] ornithologists and scientists who travel great dis[illegible] Audubon Society, in October, 1941, established the only sanctuary in the United States devoted primarily to the study and research of the bird which [illegible]

▼ Strutting and bowing on a stubbled corn field, this male crane tries to attract a mate



◀ Only two eggs are laid in the marsh-hidden nest. Destruction of nesting grounds through "land improvement" has threatened this bird

YOUR NEW BOOKS

ALASKA • EDWARD SYLVESTER MORSE • FADING TRAILS STRATEGIC MATERIALS FOR DEFENSE • SUN CHIEF

EDWARD SYLVESTER MORSE

------- by Dorothy G. Wayman

Harvard University Press, $4.50

WE have here the life story of perhaps the most outstanding American example of a man whose long scintillating scientific career rested almost entirely upon sheer native ability. Morse, who was born in Portland, Maine, in 1838 and who died in Salem, Mass., in 1925, put himself down as a specialist in zoology, ethnology, and Japanese ceramics, and there is ample testimony that he made substantial contributions in each field. In addition, it now appears, he was also a clever illustrator, an inspiring teacher, a widely appreciated lecturer, a thundering civic reformer, a modest inventor and, for the last 45 years of his life, the director of the Peabody Museum in Salem.

The author, from voluminous diaries, letters, etc., has conjured up a dynamic personality, acceptable in the main, no doubt, to those who knew Morse. The reader will meet a somewhat egocentric but likable person who as a boy was expelled from every school attended, who rebelled against his father's religion, who worked only fitfully at anything remunerative, but who from the age of twelve roamed the forest and seashore collecting shells. This hobby he pursued so effectively that Professor Louis Agassiz of Harvard University, in 1859, engaged him as student assistant in the newly opened Peabody Museum. Strangely enough, this contact, involving both formal and informal instruction from the beloved teacher, lasted only two years; but it supplied inspiration sufficient to keep the pupil going for life.

During the next fifteen years Morse gradually attained his stride in research, teaching, and lecturing. Then, in 1877, he went to Japan to study brachiopods but remained to establish the teaching of zoology, to initiate archaeological research and to gather, for himself, what in time became the world's most notable collection of Japanese pottery, now in the Boston Museum of Art. In the meantime he published several volumes of observations on life in Japan and in China—even one on life on the planet Mars! His pet ethnographic subject was that of arrow-releases. But, after an excursion of 20 years or so in anthropology, he once more turned his chief attention to zoology.

The book and its subject deserve more space than is here available. Let it suffice that Morse was showered with honors and that he retained his youthful characteristics to the end. He lived as he worked, with gusto, enjoying life to the full. The last time I saw him he was still playing his nose flute.

N. C. NELSON.

LORD OF ALASKA:

Baranov and the Russian Adventure

----------- by Hector Chevigny

The Viking Press, Inc., $3.00

TO many residents of Alaska and to most of its tourists, Baranov means simply the name of Alaska's de luxe hotel in Juneau. One hundred and thirty years ago, however, the same name was one to conjure with in the affairs of the Pacific. Time had, indeed, obliterated at the very scene of his labors all but a trace of the man who for 28 years had struggled to create an American empire for Russia. From this long neglect Hector Chevigny has resuscitated the fame and career of Aleksandr Andrevich Baranov, not as a phony literary exercise but as a vital and significant phase of the discovery and exploitation of the Alaskan empire.

Baranov was the son of a modest merchant family and was 43 years old before he was selected to go to Kodiak Island, Alaska, in 1790 as the representative of a Russian firm trading in sea otter skins.

These skins, highly prized in the Chinese market, were abundant along the Alaskan coast and formed a most profitable item of commerce.

For the next 28 years Baranov labored faithfully and shrewdly for his employers and for Russia. Against incredible odds, both of human and geographic origin, he struggled to maintain a precarious toe hold on a vast empire and a lucrative business. Most of the time he was hampered by lack of support both from his employers and his government, although belatedly his merit was recognized by an appointment as Governor of Alaska.

At the end of his career Baranov could calculate the material profits he had won in the millions of rubles. He could point to 24 separate settlements he had established. Upon him depended a population of nearly 10,000 souls. But more than these he had created an empire.

Mr. Chevigny has admirably recounted the fascinating story of this individualistic pioneer, whose prize was dissipated by incompetent successors and bureaucratic governments. The story is far more than a local incident in Russian history. It is also a part of our own.

H. L. S.

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NEW YORK, N. Y.

SUN CHIEF, *The Autobiography of a Hopi Indian*

------ Edited by Leo W. Simmons

Yale University Press, $4.25

THIS life story of an Indian was prepared by Doctor Simmons of the Department of Sociology of Yale University and published for the Institute of Human Relations. It is an intimate account of 50 years in the life of Don C. Talayesva of Oraibi (born in 1890), told in the first person, and it is as frank as the autobiography of Cellini.

The reader is likely to be surprised at Don's photographic memory, but his recollections ring true and are most convincing. Unbiased truth and frankness are rare in autobiography, but here is one of the exceptions. The material was gathered during many interviews and from a very extensive diary that Don kept in long-hand under the direction of Doctor Simmons.

Until he was ten, Don was reared as a

[illegible]

[illegible]

[illegible] Hopi way of life.

The story of this book, a white man, [illegible] status in the village [illegible] secrets which were [illegible] tribal secrets. This is [illegible] autobiography of one of our native Americans, but it has the added value of being a real contribution [illegible] study.

CLYDE FISHER

WILDLIFE OF IDAHO

by William M. Rush

The Caxton Printers $[illegible]

Wildlife of Idaho is a compact book on the mammals, birds, and fishes of that state written by the author of *Wild Animals of the Rockies*, reviewed in last month's NATURAL HISTORY. The book is intended for use in the schools for teachers of the lower grades and for pupils of the middle grades. The undertaking is praiseworthy and much of it has been well done. The language is simple and technical terms are explained when the author feels obliged to use them. Special care was taken to try out parts of the book as to suitability and interest.

Interspersed with the descriptions and explanations of relationships of the animals are stories of hunting adventures of animals and their development, told with evident sympathy. It is unfortunate that in a number of places the author taxes credulity: a beaver-hunting otter, geese trapped by street lights, an eagle that crashed into a treetop. Needless and undesirable complications were introduced in several places by describing subspecies, here called as often as not "species." The general effect of the book should be to encourage youngsters to study and enjoy the wild things about them, and to implant an interest in conservation.

The book is illustrated by numerous photographs, including a number in color. Some of these latter are not very good whether due to the originals or the reproduction. The black and white photographs of live animals are good, and are a valuable part of a book like this.

JOHN E. HILL

STRATEGIC MATERIALS IN HEMISPHERE DEFENSE

by M. S. Hessel, Walter Murphy, and F. A. Hessel

Hastings House $2.50

SINCE our government has not as yet felt the necessity of explaining to Mr. John Q. Public, as the authors too often dub him, the necessity for the curtailment of many products that he regards as practically his constitutional right, an explanation from unofficial sources is very welcome. This book endeavors to tell why many materials are regarded as strategic and critical, where, how, and how much of each is used, what the prospects are for

This is TIARE of TAHITI ↓

He is carving these rosewood "tikis," representing Taaroa, supreme deity of Polynesia.

They were brought to us across the Pacific on the last boat from the peaceful South Sea Islands of Tahiti, Samoa, Rurutu, Nuku Hiva. There Mr. Martin Anthony Brunor assembled this unique collection of figures, polished wooden bowls and other carvings, both beautiful and grotesque, representing a fast fading native art.

Impossible to duplicate, and outstanding for their strong primitive workmanship and for the handsome grain of the rosewood, mihami wood and rare cordia subcordata wood—we are proud to offer these fascinating pieces at amazingly low prices.

TIKIS

[illegible] inches high by [illegible] inches wide — $1.25 each
[illegible] inches high by [illegible] inches wide — $2.00 each
[illegible] inches high by [illegible] inches wide — $[illegible] each*
[illegible] inches high by [illegible] inches wide — $[illegible] each*

*PAIRS MAKE FINE BOOKENDS

Oval bowls approximately [illegible] inches wide and [illegible] inches long vary in price from $[illegible] to $[illegible] according to workmanship

●

White pikake shell necklaces each with more than [illegible] shells — $[illegible] each plus 10% excise tax

●

Pairs of baby giant Tridacna clam shells approximately [illegible] inches long, $[illegible] a pair

●

Kindly include 10 cents postage for each wooden carving or pair of shells. No postage for necklaces.

The BOOK SHOP

American Museum of Natural History, 77th Street and Central Park West, N. Y. C.

filling that demand, and where the shoe may next pinch.

The first section on rubber and its synthetic substitutes is very enlightening. Successive sections deal with strategic and critical mineral materials, organic products, such as oils, fats and gums, chemicals, petroleum, and so on. A brief section discusses the Latin American countries and their exports.

The work is well documented and contains an excellent bibliography. The salient statistics of production and consumption, using the most recent figures available, are listed after each discussion. The closing summary points out some fine morals about the conservation of our waste materials and of our scientifically trained brains —both irreplaceable when time is such a vital factor.

The authors are chemists, and their knowledge of minerals appears to be limited. The book could advantageously have been made a little longer, with more complete explanations of the uses of many of the materials and more information about them. One suspects that the "Frary metal," which it is said may relieve the antimony situation, may itself take metals needed for other equally essential uses. Any explanation of our present critical situation is very welcome, and here one will find not only the important facts but a handy summary of statistics and a reasonable explanation of governmental actions that superficially appear without justification in need. The WPB could profitably quote from some of these sections when they decide that shoes or woolen clothing or soap must be added to the ration list.

F. H. POUGH.

NEAR HORIZONS

--------- by Edwin Way Teale

Dodd, Mead & Co., $3.75

TO readers of NATURAL HISTORY Mr. Teale is no stranger, for his remarkably detailed pictures of insects and no less vivid accompanying text have contributed to the attractiveness of several issues of this magazine. The present volume records with spirited imagery the observations and adventures of a stay-at-home explorer whose Long Island garden has been planned not as a horticultural show-piece but as a lure and place of settlement for insects whose life histories he is eager to investigate. Yet, restricted territorially as this field of observation is, it produces—as the book abundantly evidences—creatures more bizarre in structure and more diversified in habit than the giraffe, the musk ox, the armadillo, and the kangaroo, to observe which in their natural environment one would have to range over a considerable part of the globe.

The book is written with zest. Even a reader to whom insects are only "bugs" will find it difficult not to acquire a new attitude toward these six-legged wonders under the spell of Mr. Teale's animated observations. But let no one be under the illusion that the volume is emotional at the expense of much substantial information. Patience, ingenuity, tireless energy, and an inquiring mind—not to mention wide supplementary reading—were required for the groundwork. A single short sentence—that in which the author records a cattail head as containing 147,265 close-packed seeds—required night after night of diligent counting to assure accuracy. The 160-odd pictures—many of them in series showing significant stages of a given insect's life and most of them masterpieces of insect photography—were culled from more than 10,000 photographs taken by the author.

The book supplements Mr. Teale's popular *Grassroot Jungles*, also mainly a home-site record of entomological observations.

HERBERT F. SCHWARZ.

CLIMATE MAKES THE MAN

------- by Clarence A. Mills

Harper & Brothers, $3.00

OUR readers will accept this book with a challenge. It presents an astonishing wealth of information on climate, including unexpected coincidences that bear on important changes in human life. The reader may already know that extreme fluctuations influence human life, but the author will also show him that even relatively small changes modify health and bodily vigor, and disrupt the affairs of nations. The ideal habitat is the temperate zone, but not just any part of that zone. In fact there are at present in the whole world only a few restricted areas which are capable of producing vigorous populations.

The upper half of the Mississippi Valley is regarded as the best habitat in the New World; this is the region of greatest fluctuation in temperate climates, suggesting that variety in climate is the important feature. However, it is estimated that a 10° F. rise in the temperature of the world would make most of the tropics uninhabitable, and that a fall of 10°F. would bring down upon us another Ice Age.

Long range fluctuations within these limits are believed under way still and do from time to time shift the areas of most favorable habitat, thus changing national dominance and revamping the course of history. There are interesting chapters on climatic problems relative to the success of the war. Other chapters deal with the individual's problem in selecting a climate to prolong life. In the matters of eugenics we read that the optimum time for conception is December to March.

The statements that changes in temperature precede revolutions, declarations of war, and changes in government may well raise doubts in the minds of our readers. Perhaps the logic of interpretation is carried to an extreme, but the book is worthy of serious consideration.

C. W.

FADING TRAILS

--- Prepared by a Committee of the United States Department of the Interior National Park Service—Fish and Wild Life Service

The Macmillan Company, $3.00

AN interesting story of wild animal life can be certain of a good audience. Conservation of wild life is an important theme, too, but not always so certain of a

Continued on page 223

NEW BOOKS *from* HARPER

BIRDS ACROSS THE SKY

By FLORENCE PAGE JAQUES

With Illustrations by
FRANCIS LEE JAQUES

"An estimable book so filled with the pure delight of observing and knowing birds of all kinds that it is a joy to read. The fresh breezes of the out-of-doors play through the book." — *N. Y. World-Telegram.* By the author of *Canoe Country* and *The Geese Fly High.* $2.50

TRAIL OF THE MONEY BIRD

By DILLON RIPLEY

Here is a 30,000 mile schooner voyage of humor, adventure, personalities and scientific bird lore expertly blended in a fascinating book. The author tells in delightful detail just how he collected specimens of exotic birds. Illus. $3.50

WILD ANIMALS of the ROCKIES

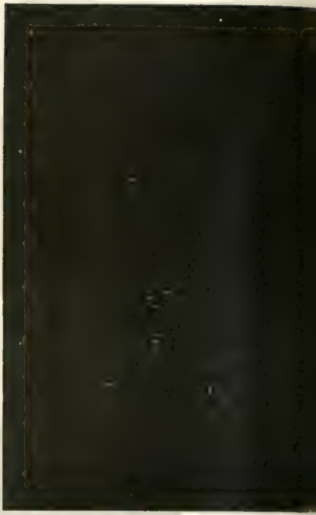
By WILLIAM MARSHALL RUSH

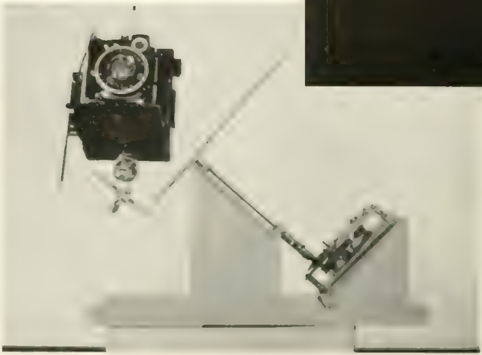
A U. S. Forest Ranger tells the exciting and personal story of his experiences with bears, deer, elk, moose, antelope, mountain sheep and goats. A chronicle rich in wilderness lore and remarkably detailed observation. Illus. $3.00

At All Bookstores

HARPER & BROTHERS
49 East 33rd St., N. Y.

ALL STAR PICTURES





Because the stars rise and set like the sun, a 2½-minute exposure of Orion produces the unsatisfactory streaks shown above. To show the stars as points (*opposite*), the camera must be made to follow them by means of a clock-work mechanism **such as the one at right, constructed by the author. Invisible stars then** appear

By Charles H. Coles

A [illegible] with the approach of winter, the stars take on a sparkling brilliance that [illegible] and stars that are not visible to the naked eye are grist for the astronomical camera.

The principal problem to be solved be- [illegible] stars across the sky. A mechanical method of causing the camera to follow the stars will obviously be more satisfactory than attempting to do this by hand, although good pictures have been made by the latter method. A simple equatorial camera mount with automatic clock drive was constructed by the author and is herein described:

The first requirement is that the camera be mounted on an axis of rotation that is aligned parallel to the earth's axis. This necessitates a shaft tilted at an angle equal to the observer's latitude. The latitude of New York City is almost 41°, so the shaft on the author's equatorial [illegible] ings allows the shaft to turn freely. A collar clamped to the shaft and resting against the upper bearing acts as a thrust bearing to support the weight of the camera.

The camera must be attached to the shaft in such a way that the prolongation of the shaft passes through the center of gravity of the camera. This permits the shaft to turn completely around with the least effort on the part of the driving clock. An L-shaped bracket made of strap iron did the trick. Holes were drilled all along its long side so that the balance point could be found by trial. A universal ball joint attached to the short side of the "L" permits the camera to be turned in any direction once it is balanced, so that different constellations may be photographed. If necessary, a weight may be attached to the other end of the "L" bar to balance the camera.

A small universal joint connects the shaft to the clockwork, so that perfect alignment is not necessary. The clockwork requires a note of explanation:

The stars, rising in the east and setting in the west, complete one revolution about the heavens in four minutes less than 24 hours, so the shaft of the equatorial must make one revolution in the same time, in the same direction. The hour hand of an ordinary clock makes one revolution in twelve hours, so a reduction must be introduced to slow its motion down to half this speed. A set of 2-to-1 gears may be used for this purpose, or, simpler, a 2-to-1 pulley drive. The author managed to secure a clock movement that originally drove the chart in a recording thermometer, and since the chart made one revolution in 24 hours, no reduction gear was required.

The complete equatorial is mounted on a board eighteen inches long, and in use it is clamped to a stool. The base of the equatorial is leveled carefully with a carpenter's spirit level. The main shaft, or polar axis, as we may now call it, is pointed at the North Star as accurately as possible.

In some locations—for example, close to the south side of a building—the North Star cannot be seen, so a magnetic compass is needed for orientation. The magnetic variation must be taken into account, however, because this may amount to as much as 20° and so throw the equatorial out of proper orientation. At New York City the needle of a compass points about

11° west of true north. By checking the compass on the North Star, the variation may be found sufficiently close for practical purposes. Be certain that the steel shaft of the equatorial is not close enough to the compass to add an extra error.

If a certain location is found to be a favored one for photographing the heavens, a true north-and-south line may be laid down permanently, so that the equatorial may be aligned quickly at any time. The author has marked such a line on a window sill where the equatorial is often set up. This north-south line was determined in the following way:

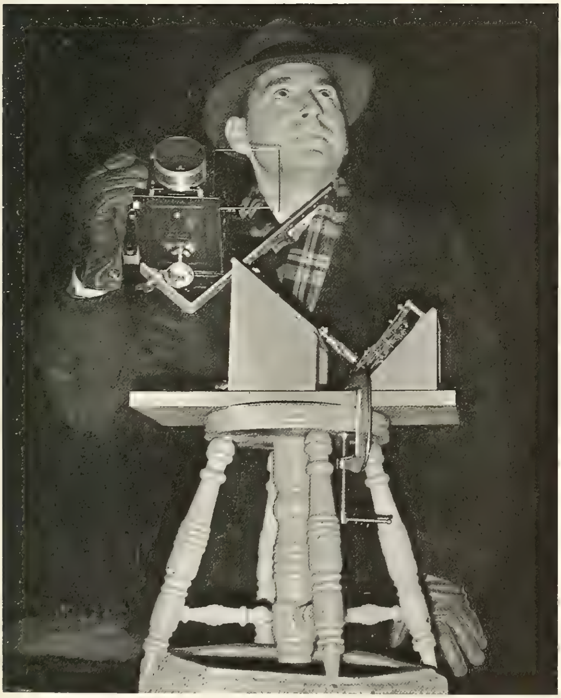
The equation of time for the sun was looked up in an almanac for the particular day upon which the line was to be established. This figure tells how far the sun is ahead of or behind a clock running on Eastern Standard Time. A correction, in this case of –4 minutes, had to be applied because the author's house was 1° east of the 75th meridian. By watching a clock that had been set by radio, the author then knew the moment the sun was directly south—the moment at which a sundial would register noon. The cord of a plumb bob casts a shadow directly north and south at this time. Two pins were pushed into the window sill at this moment along the shadow of the plumbline. The two pin pricks were later connected by a line.

	hr.	min.	sec.
Sundial Noon	12	00	00
Equation of Time for November 3, 1942 (subtract)		16	22
Correction for location 1° east of 75th meridian (subtract)		4	00
Eastern Standard Time of Sundial Noon	11	39	38

When taking pictures of the stars, keep the exposure as short as possible to reduce any error that inaccuracy in the clock drive may introduce. Use, therefore, the fastest film available and open the lens to the maximum extent. With a Super-panchro Press film, the author uses an exposure of five minutes with an aperture of f/4.5. Because of the glow in the city atmosphere, a longer exposure might result in fogging the film and would reveal no fainter stars. In this five-minute exposure, stars of the eighth magnitude are readily photographed. Thus, many stars invisible to the naked eye are recorded, for it is only possible to see stars of a magnitude of six or six and a half.

Recording faint celestial happenings with such a camera is a novel experience for the photographer who likes to dabble in the infinite, and a little practice should bring very satisfying results.

Neither telescope nor telephoto lens is needed to penetrate the heavens beyond the range of the naked eye. The drive shaft must lie north and south



ALL STAR PICTURES

INFORMATION TEST

A few informational high spots that may be gleaned from this month's Natural History

Correct answers on page 224

1. What country produces practically all of the quartz available for vital war use?

2. What animal carries its young on its back, can be very much alive when it looks dead, and has a pouch?

3. What well-known household chemical was named after the ancient temple of Ammon-Ra in Egypt?

4. Which is larger, the rhino or the hippo?

5. Because she spun and worked upon a single thread, a good maiden lady was called a —.

6. The summit of the Devil's Tower, in Wyoming, is devoid of life.

True......... False.........

7. Man is the longest lived mammal.

True......... False.........

8. It takes 23 baby opossums to weigh as much as

(a) a penny

(b) a pound

(c) an adult opossum

9. What famous grass widow of history could tell a good yarn as well as spin one and unraveled at night what she had done during the day?

10. The rhino's main weapon is

(a) bone

(b) horn

(c) hair

Answers to Qestions on pages 192 and 193

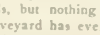
1. [illegible]

2. [illegible] phant. But this is really ridiculous, for [illegible] about getting foreign matter in its trunk. [illegible] and if a mouse accidentally did get in unseen, the elephant would certainly blow the little rodent out with tremen- [illegible] than a few inches. Eddie Allen, a well-known elephant expert, once trained [illegible] on (but not in) its trunk.

3. Snakes are not endowed with any un- [illegible] escape from difficult problems. So far as is known from limited experiments, venomous snakes could not as a rule commit suicide if they wanted to, because they are to a large extent immune to their own poison.

4. This story usually gains color by the supposition that enormous stores of valuable ivory tusks may be found in the places the elephants have made into graveyards, but nothing like an elephant graveyard has ever been found, and there is no basis whatever for this belief.

5. Yes, it is entirely possible for the horned toad to squirt blood from its eyes. The eyes bulge in their sockets when the animal performs this astonishing and awe-inspiring feat, and there is a distinct sound, likened by Ditmars to that produced when one presses the tongue against the roof of the mouth.



6. Chameleons do change color when angry or afraid or under the influence of sudden changes in light and temperature; but a change is not influenced by the shade of the object upon which the reptile rests.

ROWDY

A Fox that lived in two worlds

[illegible] shire School in Sheffield, Massachusetts, I had the crazy luck on April 3, 1941, to capture a baby red fox simply by stalking it [illegible] real imagination in placing his puddles.

[illegible] shook their knowing heads. "He'll never live." "You can't housebreak him." "He's certain to become vicious." I named him "Rowdy," put a box of sand in each corner [illegible]

By the middle of June I had a real fox on my hands and one whose devilish cunning could no longer be taken lightly. Though housebroken as long as the world [illegible] conformist. He spent most of his time in my room where he could sit in the sun, peruse my personal effects, tear a towel or two, or simply rest between rounds. His play was constant, well meaning, and murderous. If he had not been loved, he would certainly have been throttled on a dozen different [illegible]

At the close of school I shut my eyes to a $25.00 offer for Rowdy and decided to return him to nature. I carried him in my arms to his old den on the mountainside and there released him, certain that I would see but a flash of his red tail as he went out of my life forever. Instead, bless him, he followed me nearly a mile back to school, necessitating a return trip to locate him at his den.

As Rowdy lacked a mother's training, many thought he would not be able to fend for himself, but from watching his play I knew that his instincts were all he needed. [illegible] that this particular area was a game preserve. During the next few days I visited him regularly at his den, taking him food and watching him romp for an hour or so.

When I left him for the last time, he sat motionless beside his den, seeming to understand as he watched me slowly going away from him.

I did not visit school again until the middle of the following September, two and one half months later. Rowdy had not been seen since June, but foxes had recently been taking food left for them behind the stables. Early in the morning the music master and his wife took me to the spot. For a few minutes we stood watching and conversing in low tones.

Suddenly a red fox appeared at the edge of the woods! Could it be Rowdy! With hamburger as a lure, I spent the next fif- [illegible] trying to coax him to me. All to no avail. I snapped my fingers, whistled, and cursed him as I used to do, but he only crouched in the path and stared unknowingly at me. This was a strictly wild creature.

However, bits of hamburger tossed out gradually brought him nearer. At last, with great caution, he actually fed from my hand. There could no longer be any doubt. This was Rowdy! Yet I could not draw the slightest sign of recognition from him. Too soon his appetite was satisfied and he began to think of leaving. I decided on a last desperate chance. With great difficulty I lured him once again to my hand. Then, with my heart beating, I cuffed him playfully on the side of his head. Instantly I was greeted with a playful charge. At last I had touched the right key.

He lashed the air with his great brush of a tail. With bewildering agility he danced circles about me. Taking my hand in his teeth, he would mouth it with pretended ferocity.

We chased each other until I was completely exhausted. Then I threw apples to keep him entertained while I rested. The airy grace with which he capered over the landscape was as smooth as a breeze-tossed bubble. When a rain cape was casually tossed on the ground, Rowdy snatched it and raced 100 feet or more to hide it behind some bushes.

For all his play, however, he remained very noticeably a thing of the wild. Apprehensive and skittish, he would bolt for the brush at the slightest unexpected move or sound. He delighted in chewing my fingers but refused to allow me to stroke his head and preferred to keep just out of reach. When, for the sake of a picture, I grabbed his front paws and lifted him clear of the ground, he chewed my fingers with increasing vigor until I was forced to put him down.

Our playing continued for nearly an hour. Then with no hint of a warning, Rowdy was gone. He left as silently and mysteriously as he had come.

Rowdy has never identified himself since. Surely here was an animal of two worlds, and I am sure he is happy in the wilderness which belongs to his kind.

NORMAN D. HARRIS

South Byfield, Mass.

LETTERS

SIR:

May I take this opportunity to congratulate you on your exceedingly interesting NATURAL HISTORY Magazine. I find it [illegible] the best presented paper of its kind and its contents the most interesting of any magazine that I read.

F. W. [illegible]

Museu Paranaense, [illegible]

Ponta Grossa, Brazil.

SIR:

Since many soldiers and school teachers who are interested in natural history frequent our Library, which we are endeavoring to enlarge, we should appreciate receiving a free subscription to the magazine NATURAL HISTORY if possible.

ARTHUR R. BENSON,

Director, United Service Organization Club

Macon, Ga.

NATURAL HISTORY readers who wish to sponsor subscriptions for this

(Continued on page [illegible])

< "One day while I was teaching at Berkshire School, I stalked a fox and took as my prize 'Rowdy,' who chewed my fingers all the way back to my room"

^ "This time it might be said that the fox had 'swallowed the canary.' Rowdy would stretch his legs out behind him and lie grinning devilishly from his round furry mass"

< "Rowdy felt perfectly at home while sharing my room. There was no article or corner that he did not consider his own. He felt equally justified in chewing my fingers and ripping my clothes"

> "It was always well to read my mail before putting it in my desk. For Rowdy was adept at opening drawers and would soon censor it to bits"

v "Looking at him one night as he quietly chewed his tail, I realized it was unfair to Rowdy to keep him from his natural environment. I decided to carry him back to his home on the mountainside at the close of school"

"By September, Rowdy was again a creature of the wild. But when I cuffed him playfully on the side of his head, he recognized me and we played one more hour together" >

LETTERS

[illegible] several [illegible] are allowed [illegible] [illegible] the [illegible] [illegible] [illegible] [illegible] will [illegible] [illegible]

* * *

[illegible]

I think NATURAL HISTORY Magazine is the best magazine that I have ever read. I would like to see [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] groups in the balcony of African Hall. . . .

[illegible]

Philadelphia, Pa.

[illegible] [illegible]

* * *

[illegible]

[illegible] the mating of a male and female walking stick (Phasmidae). The male is the small insect hanging from the top, and the female is stretched tightly against the tree, head down, with her two front legs in front of her head.

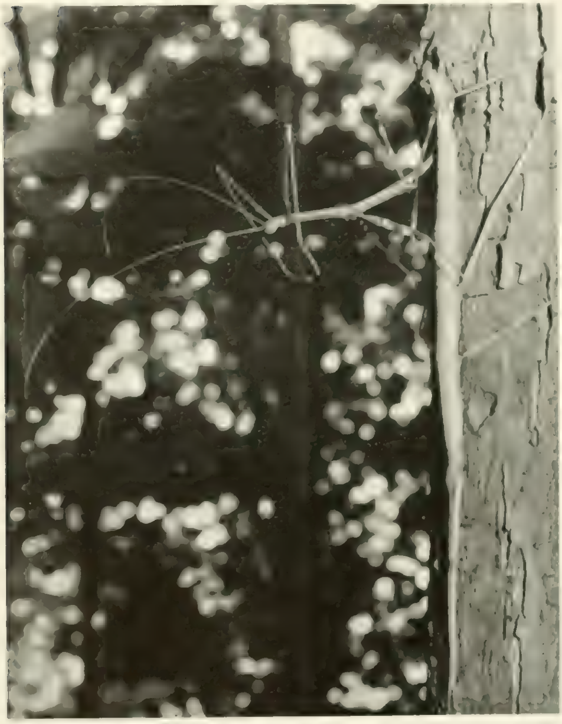
[illegible] N. Y. [illegible] When I returned with a camera three hours later, the insects had not changed their positions.

[illegible] occasional letters about snow rings. So far I have [illegible] as a result of the pictures published in NATURAL HISTORY last winter.

[illegible]

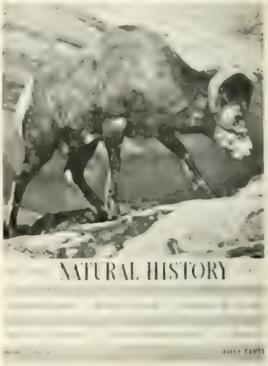
Duanesburg, N. Y.

Male and female walking sticks



NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $[illegible] each, with full credit to the photographer. Return postage must be included.

THE COVER THIS MONTH



The Bighorn Sheep is the only wild sheep native to the United States. The several varieties, some of which have been designated as distinct species, formerly were found from Mexico to Alberta and British Columbia, but the range is now greatly restricted. The animal represented on the cover in Kodachrome is *Ovis canadensis* Shaw. It keeps to the rugged mountains far above the tree line and only descends when forced down by deep snow. In the foreground is seen a Say ground squirrel or "big chipmunk" as it is called in the West. The setting is Jasper National Park, which provides an appropriate background scene for the display of this animal in the recently opened Hall of North American Mammals in the American Museum. The group of which it is a part is a gift of Mr. and Mrs. H. P. Davison. This brilliant example of the taxidermist's art was mounted by Robert H. Rockwell under the direction of James L. Clark, and photographed in color by Thane Bierwert. The well-known artist Belmore Browne, assisted by George Browne, painted the background of the group.

URGENT

The Museum Library is in need of back issues of NATURAL HISTORY, particularly the first four issues for 1942. Copies sent to the Librarian, Natural History, New York, will be greatly appreciated.

Continued from page 217

sympathetic reception. Too many persons are allergic to the demands of conservation because they do not understand the issues at stake and they do not have the story presented in an attractive form.

The present book is a happy blending of the objective and subjective aspects of endangered American wild life. The reader finds the story told so entertainingly that his interest does not lag and yet the object lessons are there for all but the most heedless. What a rich fauna was disclosed to the early explorers of North America and what sad inroads have been made by the subsequent human occupation. How many significant actors in the wild life drama have taken their last bow. How many are today awaiting their call for a farewell to the American audience.

Fading Trails is the story of these events and selects the most important and most impressive examples. We are told what these mammals, birds, and other animals mean to us. We are informed as to the circumstances which threaten the existence of the species. We read of the measures taken for their protection or the things which should be done but have not because the public has not been aroused.

Conservation of wild life can be preached as a sermon. But, for those who do not care for sermons, let it be said that the reader of *Fading Trails* is not given dogma to be taken on faith alone. The account is logically presented and the arguments are forceful. There can be no question as to the desirability and the wisdom of conservation.

The attractive illustrations by Walter A. Weber, four of them in color, are excellent.

This authoritative, well-written book is highly commended to nature lovers and to those who have not as yet discovered nature.

HAROLD E. ANTHONY.

LIVES AROUND US

---------- by Alan Devoe

Creative Age Press, $2.00

ANOTHER volume of nature sketches by Alan Devoe has just come from the press. In *Lives Around Us,* the author has given 20 essays or sketches portraying the life histories of creatures that almost any one could observe accurately but rarely does.

Mr. and Mrs. Devoe live on an old farm of more than 100 acres in the Hudson River valley. This land is kept as a wild life sanctuary. Here Mr. Devoe becomes intimately acquainted with the weasel, the fox, the woodchuck, the great horned owl, and the tiger of the air. His observations are accurate, and he tells about them in such a fascinating way that you want to read more about these animals or go out and make observations for yourself. His writings are free from sentimentality. He does not personify his creatures, but in writing about them he brings the fields and the woods to the reader.

Insects come in for their share in this volume. The author gives us intimate life histories of May flies, cicadas, mosquitoes, locusts, and grasshoppers. Especially good is "A Triumph of Instinct: The Dauber Wasp." It is complete and beautifully written. But so is the story of the snail, the turtle, the frog at the pond, and "Spiders: The Trappers of Outdoors."

The book is illustrated by 22 excellent full page woodcuts by Frank Utpatel.

As a naturalist, Mr. Devoe has explored the fields and woods since boyhood. One critic describes his books as "the finest writing of their kind since Thoreau." He has contributed to the *Readers Digest, The Atlantic Monthly,* and other worthy magazines. In a world torn with war and strife, this book comes as a refreshing interlude.

O. P. MEDSGER.

BIRDS OF NORTH CAROLINA

------ by North Carolina Department of Agriculture

State Museum, $3.50

FOR Americans interested in the birds of their own country, the "state list" forms the backbone of ornithological literature. Standard accounts of the birds of several states date far back into the last century. In our time, however, these have been succeeded by a new generation of books that have profited by the multiplicity of published articles and notes and by the findings of an ever-growing number of fieldworkers.

Among the southern commonwealths, North Carolina occupies a distinctive place because it was the first to enact laws dealing with the conservation of wild animals and the seasonal production of game species. In the production of a state list of birds it was also a pioneer. As early as 1913 the first edition of the present work by Pearson and the Messrs. Brimley was in the final stages of printing, when the entire undertaking was destroyed by fire.

Fortunately a complete copy of the text was preserved in the form of printer's proofs, and the work was finally issued as the first bird book of the region.

In the present publication we have a complete revision of the earlier edition, with a large number of additional illustrations, including plates furnished without recompense by the artists Brasher, Horsfall, and Peterson. Equally gratuitous services by the three authors has made possible the publication of the new edition at a low price, although the text has been increased from 380 to 416 pages and the forms of birds described have grown from 342 to 396.

The work opens with an historical sketch of ornithology in North Carolina. This is followed by a brief review of recent and contemporary research. In keeping with the special interests of the authors, the next section is devoted to bird protection. The subsequent systematic accounts of the species and subspecies include a description sufficient for identification and a statement on range and season. The brief life histories have a refreshingly original stamp, showing that they are

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[illegible]

THE SEASHORE PARADE

by [illegible]

[illegible]

THIS [illegible] life of the Atlantic seaboard and would be [illegible] use it in that way.

For instance, the common Pacific Coast [illegible] or the commercial deep sea scallop (*Pecten magellanicus*). The same criticism would apply to the starfishes, worms, chitons, [illegible]

"Sharp spines" are not removed in pre- [illegible] these sponges never had any, as in noncommercial sponges. Jellyfish tentacles have sting-cells throughout their length, not merely at the end. It is most inaccurate to say that "jellyfish manufacture electricity," since their luminescence is clearly the result of a chemical process.

The statement that the coral opens and closes a door at the top of its limestone house is incorrect. The coral calyx is open at the top and never possesses a "door." Nor do the tube feet of starfishes "open and shut like medicine droppers." They terminate in closed pneumatic disks which are controlled by the pressure of the water vascular system distending them.

In a book which aims to deal with the facts of seashore life, it is unfortunate that the illustrations should be gaudy and unreal modernistic pictures, rather than those of a realistic style. While, as a whole, the book has some features of merit and shows a most sympathetic attitude toward children, it is a serious mistake that its special Pacific locale should not have been clearly defined to the youthful reader.

ROY WALDO MINER

JOHN TORREY, A STORY OF NORTH AMERICAN BOTANY

by Andrew Denny Rodgers, III

Princeton University Press, $3.75

THE author first became interested in the history of botany in America through his grandfather, William Starling Sullivant, the pioneer authority on mosses. His biography of Sullivant, entitled *Noble Fellow*, was so well done that he was encouraged to set forth the lives of other great pioneers in botany. It is not surprising that the next subject he selected was John Torrey, who has been called "The Father of American Botany," and who was a contemporary of his grandfather, the great American bryologist.

This life of the great botanist and chemist, with special reference to the early history of botany in America, is made more attractive by a spray of the evergreen, *Torreya* on the jacket, a title-page photograph of the "gauntly beautiful" Torrey Pine, and a fine frontispiece portrait of John Torrey.

To Torrey came most of the botanical materials collected by all the great expeditions of his time, the military and geographical explorations and railroad surveys concerned with the winning of the West. After classifying this valuable material [illegible] He had most to do with organizing the herbarium of the Smithsonian Institution. Asa Gray, who [illegible] was once his pupil. Naturally the Harvard College herbarium profited greatly by the work of Torrey. Torrey's private collection went to Columbia College and is now installed at the New York Botanical Garden. This is an excellent biography, a very human story presented with great care of one of America's early scientists who had so much to do with organizing our great scientific societies, journals, academies, museums, and herbaria. It is dedicated to the Torrey Botanical Club.

CLYDE FISHER

Answers to Questions on page 219

1. [illegible]
2. [illegible]
3. Ammonia was named after the temple of Ammon Ra because the priests prepared a bleaching powder which worked because of the ammonia it contained.
4. The rhinoceros is larger, being second only to the elephant among living land animals.
5. [illegible]
6. False. Despite its apparent inaccessibility the top of Devil's Tower is inhabited by chipmunks.
7. True. In spite of a common belief that elephants and other animals live to great ages, man under civilized conditions exceeds them all in average life span.
8. Twenty-three opossums weigh the same as a penny. The adult opossum weighs from [illegible] to 15,[illegible] times as much as the young.
9. Penelope, the wife of Ulysses, who told other suiters they must wait until she finished the work on her loom.
10. The "tusks" of the rhino are neither bone nor horn, but are compacted hair.

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LETTERS

Sirs:

I cannot tell you how much I enjoyed George Miksch Sutton's article, "A Modern Audubon in Mexico," that appeared in the October issue of NATURAL HISTORY Magazine . . . JOHN C. MUZZALL.

Coopersville, Mich.

* * *

Sirs:

My family has subscribed to NATURAL HISTORY for many years, and we all really love it. I have been particularly interested in the photographs of wild birds and insects. Enclosed is a picture I snapped this summer near Eugene, Oregon, of a Western Tiger Swallow-tail (*Papilio rutulus*) feeding on a thistle. There were many of these beautiful lemon yellow and black butterflies in the hills.

JOCELYN CLISE.

Seattle, Wash.

* * *

Sirs:

. . . We think that NATURAL HISTORY Magazine is the best and most interesting magazine we get.

The only criticism which I personally have to make about NATURAL HISTORY is that recently it has been getting to look more like ——— and ———, that is, with photographs taken in a way to be sensational . . . HENRY SCHMIDT.

Philadelphia, Pa.

* * *

Sirs:

I know many others besides myself have agreed that NATURAL HISTORY is the finest magazine in its field.

As one who is greatly interested in photography, I can truthfully say that NATURAL HISTORY is also the best magazine on photography. I have seldom seen the equal of the photos, especially the covers in color. And the articles by Charles H. Coles are the best and most useful ones I have ever read. They should be printed in book form. FELIX OSER.

Woodside, L. I., N. Y.

* * *

Sirs:

I thought I would write you and say how much I enjoy and look forward to your Saturday lectures for Members' Children. My father is a member of your Museum, and our family never misses your lectures. . . I remember your thrilling movies of Africa that I saw years ago. You do the whole business so well—I'm sure that if I were little I wouldn't be bored or restless. I did come when I was very little, and I was very excited to see the movies, then a great treat.

Perhaps you don't realize what a "service to humanity" you are doing, with your museum, the magazine, and the lectures. Your whole institution has been very important in our life, and I hope you will always be successful. Thank you for it. SHIRLEY WORCESTER.

New York, N. Y.

* * *

SIRS:

"Coaxing earthworms up out of the soil" as discussed by Clifford B. Moore in the November NATURAL HISTORY is quite contrary to the common practice around Twin Falls, Idaho, where many people get night crawlers (very large angleworms) with an electric outfit. I use such an outfit on occasions when I have not had time to get them at night with a flashlight. . . .

These large worms I am told were inported here from the East. They are thick in many of the lawns of the town and in the garden and flower plots. If we have time, we give the lawn a good soaking before using the electric outfit, as we find the current is much stronger and the results quicker.

Some of the electric devices have two wires, but mine has one wire leading from the push-in socket in the house, outdoors to the two small steel rods which are stuck in the ground two to four feet apart. In a couple minutes the worms begin to appear, some headfirst and some tailfirst, struggling as though in pain. On a hot day when the surface of the lawn is dry, the worms will lie on top; but generally the grass is damp, and the worms begin to move away as soon as they are up. They crawl pretty lively, and when they get three or four feet from the steel rod they burrow into the earth again. I don't have much success just setting the outfit and going away for ten or fifteen minutes to work in another part of the yard, but must stay on the job. When one is about half out, I grab it quickly and jerk it out easily. If grasped slowly, the worm swells and sticks in the burrow. . . .

I have gotten as many as 23 big worms from one set; and my son told me he got 40 from one set. A neighbor boy has made part of his spending money selling night crawlers for some years and has

Continued on page 276

Natural History

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Above illustration—Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ALBERT E. PARR, Director

VOLUME L—No. 5 ★ ★ ★ ★ ★ ★ **DECEMBER, 1942**

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From a Kodachrome of Lychnosphaera regina *by Charles H. Coles*

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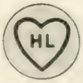
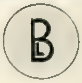


▲STRENGTH AND WISDOM personified. The elephant seems able to do everything except read the company's brand on a log *(lower right)*. A heart with "H. L." was used after Harry Lingard, the author's host on the trip, had O.K.'d a log



TRAINED TUSKERS
of the Teak Forests

By TRUMAN BAILEY*

All photos by the author

Into the jungles of Siam to observe the elephants whose fame is a byword for intelligent cooperation between animal and master

HARRY LINGARD, who knew more about elephants than any other white man in Siam, died of jungle fever not long after we made the expedition into the teak forests I am going to tell you about.

At first Lingard objected to taking a stranger with him into the jungle to observe how the elephants work and are trained. He had gone out there after the war and had spent most of his time on the Burma-Siam border. He spoke fluent Siamese and Laos (pronounced as if the 'd' were left off 'loud'), and was respected by the natives as a stern but kindly supervisor. Once he gave consent to my accompanying him, however, he proved a helpful host and a delightful companion.

Concern was shown on every hand regarding my ability to stand a jungle trip, particularly with Lingard, who was noted for his drive. He dryly promised me an exciting trip. However, I could not see that it should be more difficult than any of the hundreds of trips I had taken into the mountains of Oregon packing my own kit. So I bought a pocket notebook in the market place at Lampang, with a portrait of King Prahjadhipok on the front cover, and packed my camera and other meager necessities for the trip. It is from the pages of that diary that I give you this account, almost verbatim.

On the morning of our departure I awoke to a din of barking dogs, howling babies, and crowing roosters. From my window I could see Cole, the thick-necked Chinese pony that looked like a T'ang sculpture, being warmed up by the stable boy. Cole was to be my mount; Lingard would ride Revelation. Between the two there was little choice. Cole was a devil with a tough mouth and an insatiable desire to go first, Revelation shied at every chip of paper or native.

For 25 miles over the roughest sort of trail we did a mad "Paul Revere." Seemingly there was no wear-out to our tough little mounts. Our trail wound through a thick jungle growth in which every branch was heavily encrusted with hungry thorns, which raked our backs and ripped long tears in our shirts. Frequently our sun helmets would be snatched from our heads by a particularly vicious tree. A Russell's viper slithered through a shallow pool and into the thick brush, giving Revelation something to shy at. Sometimes we dragged our ponies, slipping and lunging down creek beds filled with tepid water. Snakes and leeches filled my mind as we waded waist-deep.

The maze became more impenetrable, and finally, Lingard, exasperated at his failure to recognize a familiar landmark, inquired of a native squatting in front of a jungle hut guarding a rice paddy from marauders. Information was denied, until for a few pennies the austere gentleman was employed as our guide. We then started across the rice fields at a killing pace. The ponies kept slipping down into the muck and had to be led. After several hours of apparently aimless scurrying, we came out on a clearly defined bullock track which Lingard recognized.

On a swimming horse

Our troubles were not over yet, as there were three rivers to cross. As they were in the rise, I was filled with concern for my precious photographic equipment. In the first one we waded for 300 yards, getting wet to the stirrups only, and struggled up the steep bank. The jungle closed in again. The next river was more threatening. Cupped between narrow banks, the water swirled and eddied, and it was obvious we would have to swim. I prepared to dismount, as it seemed impossible that the tiny ponies, thirteen hands high, could swim with us; but Lingard said to stick on unless Cole started to flounder. I tucked my precious camera inside my shirt and prayed to the luck goddess that it wouldn't be lost. It was amusing to note the serious businesslike attitude of both ponies. After about 75 feet of shallow water, we slipped with a sudden lunge into the main channel, and the horses were swimming. The sturdy little mounts never faltered. Soon we were clambering up the slippery bank. Here Cole slipped and whacked his nose. I dismounted willingly and helped him up the bank, feeling grateful indeed for the good work he had done.

The final river was not difficult, and after a brisk canter we pulled up at the Wat (native church), hungry as blazes.

It is an accepted custom for whites traveling through the jungle to avail themselves of the native churches for shelter. So long as the visitor complies with the regulations imposed by the

---

* TRUMAN BAILEY is known to readers for his contributions to NATURAL HISTORY on Samoa and the ancient ruins of Angkor. By foot and on bicycle or animal back he has explored many parts of China, Japan, and other oriental countries, as well as numerous islands of the Pacific. Much of his attention as an artist has been devoted to the preservation of native artistic traditions in a machine-dominated age. His pioneer work in "discovering" and developing obscure crafts has reinforced the cultural individuality of many people and brought them greater economic freedom, at the same time that their creative talents have enriched the world. In the anthropological sense, his work is a phase of conservation—a sorely neglected one. As this goes to press, he is flying to South America under the auspices of the Inter-American Development Commission to conduct a protracted survey of native arts and their possible bearing on the lives of North Americans.—ED.

► A JOURNEY into the teak forests along the Burma-Thailand border is a strenuous undertaking and is not frequently made by men not in the business. The trip by the author to photograph the work of these trained elephants was made on horseback with elephants transporting the baggage. Transport work of this type is generally done by tuskers too old for heavier duty and by trained calves serving their apprenticeship. So difficult is the task of removing the timber that five to ten years are required from the time a tree is felled until it is drifted downstream to Bangkok

▼ HUGE BASKETS distribute the load evenly. Lack of refrigeration in the primitive camps necessitates transporting fresh meat "on the hoof," and live chickens and pigs are conveniently conveyed in these baskets. If an elephant is overloaded, a shrill trumpeting of protest gives instant warning

[illegible] He [illegible] are allowed, and no women can sleep [illegible] From the [illegible] the Wa[illegible] [illegible]ly made airplanes—prophetic of the world to come in this remote land.

We dined well and on spotless linen: fish patty, chicken, a delicious soufflé with figs, coffee, and chocolates out of a tin.

From the Wa[illegible] the trail was too rough and slippery for riding and for the most part followed the creeks [illegible] This involved checking for defects, sawing off faulty or hollow ends, ascertaining depth of pits or holes by running a stiff wire into them or a bamboo split if deep, and finally branding them over the length of the log on behalf of the Borneo Company. Sometimes a particularly good log received the brand of approval on both ends, and of course there would be trouble if this log arrived minus one brand.

Five to ten years from the time a log is cut until it arrives at Bangkok sometimes pass. Two years at this is required to dry the logs so that the heavy wood will float. A season is allowed for the elephants to get the logs to water, and another season awaiting a rise. Then it will take another season to get the wood to Bangkok, possibly much longer.

The day we traveled to our camp we covered 25 miles on horses and 20 miles on foot. But we were rewarded by, of all things, a "shower bath." We stood on a "bath mat" of velvety banana palm leaves in a square enclosed by black cloth (black so it would not attract mosquitoes), and buckets of water were fetched by our personal servant. Then the business of soaping and sluicing began. What luxury, I thought, as the boy stood at attention awaiting the signal for the final bucket. In the distance thunder started its evening growl, and the first heavy drops of rain fell on my bare skin.

Tired but relaxed, I reclined to puff on my pipe and write my notes while Harry Lingard interviewed his jungle workers, sheltering themselves from the gathering storm under large parchment umbrellas. My diary reads: "In native dialect notes are compared, salaries paid, events discussed. All this is the business of taking teak out of the jungle. Large drops fall on the thatched grass of our shelter with a soothing splatter. Through the gloom

of early evening the light from the cook shack gives evidence that dinner is on the way. A 'Coleman' gas lantern, reminiscent of home in Oregon, hangs behind me. . . . In the distance I can hear the musical note of the wooden elephant bells. The mingled odor of our supper and the smoky tang of the always damp jungle firewood, drifts to my nostrils.

"A coolie just came in who was on hand when a wild tusker, intent on conquest with one of the worker females, killed a fellow coolie. The account runs that a group of workmen tried to kill the tusker for the damage he was doing to the camp and neighboring rice paddies. They were blazing away with ancient Winchesters when the bull turned and charged. This one poor fellow stumbled and fell, and the maddened elephant, kneeling upon him, rammed him through with his tusks.

"The coolie who is telling the story is typical of Siamese workmen. He receives a food allowance of 4.00 ticals ($2.00) each month. Other than this he does not draw his salary for eighteen months. One day soon he will collect, have one grand drunken, gambling, opium-smoking orgy and with a very sad head will return to work for another eighteen months.

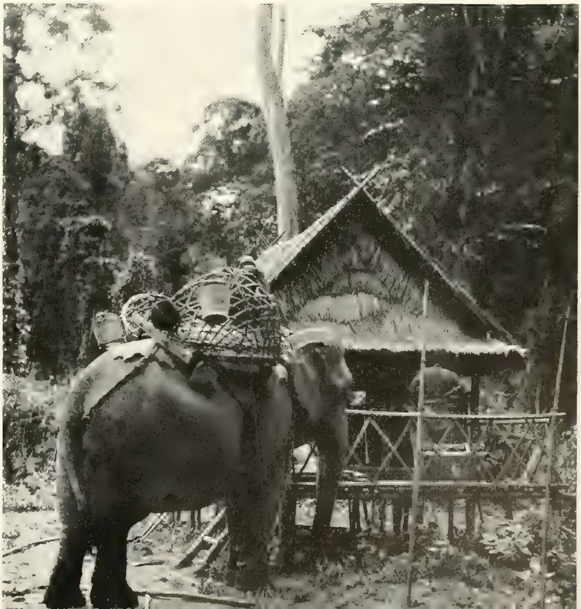
"Today . . . I saw a most amazing sight—elephants working a sidehill so steep it was incredible how the huge beasts could save themselves from slipping into the gorge. They were pushing great logs down the hillside, which crashed to a resting place at the bottom of a ravine, whence they will be snatched by the flood waters when the stream rises to full height.

"There are many questions to ask about elephants, and it is fascinating to get Lingard talking on his favorite subject. His knowledge is profound, embracing many years of intimate firsthand experience. He is extremely tolerant of some of my sillier questions. One of these, the fable of the common dying ground of elephants, he answered positively. Elephants die like any other animal. Many of them, in pain, rush out into the jungle to be seen no more. Most of them die as unromantically as horses. He has been on hand for many such departures.

"He knows every one of the hundreds of elephants we have seen—its idiosyncrasies, age, and condition—and at a glance can tell whether it is being well treated or poorly. The elephants know him, too, and respond to his caresses. Ordinarily elephants hate the smell of whites and will show their distaste in violent ways. I was no exception and found it safer to keep my distance.

"An elephant carries its young 20 to 24 months. It is said that bull calves require the longer period. They nurse for three years. It is not unusual to see two mothers nursing the same calf when one of them has lost her baby."

▼ A JUNGLE CAMP is thrown up quickly from the bamboo and thatch near at hand. After a short period of use the hut must be destroyed, as it becomes infested with scorpions, centipedes, and other undesirable occupants. The stilts that raise it off the ground are a protection against moisture and snakes. This hut is the Borneo Company's Lampang Camp No. 3



◀ ALL LUGGAGE must be covered with tarpaulins, as the sun rarely shines for more than a few minutes. Even in the dry seasons there is an almost continual drizzle of rain, which swells to a heavy, unremitting downpour during the wet months. Elephants are capable of two or three miles an hour, or 25 miles a day. They tire easily at a faster pace and rebel at greater distances if heavily loaded

▶ A THOUSAND POUNDS of green fodder and 25 pounds of unhusked rice are consumed daily by a full-grown elephant. However, the animal is content with many varieties of herbage and picks up most of its food along the trail while working, so that low upkeep is a strong point in favor of the elephant. A great fondness for rice leads elephants into mischievous raids on native rice paddies. The outraged farmers, frequently seeking reimbursement far beyond the damage, are required to file their complaints in the home office at Lampang

◀ THE TWO-YEAR-OLD PET of the teak camp at left was as playful as a puppy. Sauntering along with the working elephants, he would fill his trunk with water from the stream and squirt it at whatever object he considered a fair target. With unerring accuracy he would drench rocks, older elephants, and even the inquisitive photographer

▶ COW ELEPHANTS generally produce one calf at birth, but twins have been known. In nursing, the calf curls its trunk back over its head to reach the mother's breasts with its mouth. The young elephant procures its food in this way for two years, not only from its own mother but sometimes from another elephant who has lost her own offspring. Training for the teak forests begins soon after three years

◀ A SEVEN-YEAR-OLD CALF, which will require another six to nine years of training before it becomes a full-fledged teaker. Meanwhile it will do chores around camp and may be harnessed to light tasks such as hauling rice. The elephants enjoy their work and are pampered by their masters. Among the Karen tribe, famous for their training of elephants, a child will ride a young elephant as an American child would ride a Newfoundland dog. The calves require affection, understanding, and patience, for a harsh word may destroy an elephant's usefulness

⊻ SURE-FOOTED AND REMARKABLY INTELLIGENT, this colossus of power performs tasks for man in the almost impenetrable forest, where mechanical tractors would be of little use. Streambeds are used extensively for hauling. The footing is rocky and slippery, and a torrential downpour may bring an instant rise of several feet in the water. Properly harnessed, a mature elephant can drag four tons over rough ground

◄ GOLD OF THE JUNGLE: teak logs lying along a streambed in the forests of the Burma-Thailand border. The logs are branded on both ends—a respected mark of ownership corresponding to the branding of cattle in our western states. There will of course be trouble if the brand is missing on one end

► SLOW BUT SURE, the elephant needs only a narrow track down the steep clay bank of a river. With remarkable sagacity, the animal maneuvers the logs to the river's edge, where flood waters will in time sweep them down stream. The logs have been seasoned for two years to make them light enough to float

I learned that an elephant starts training soon after reaching three years of age. At thirteen it is completing its apprentice stage; at nineteen it becomes useful. At 35, perhaps 40, an elephant achieves its prime. At 50 years, on the average, its period of usefulness is ended.

In this locality the Karens, a northern tribe, buy calves at the American equivalent of about $250.00 each and will exchange three calves for a trained elephant.

The elephants require affection, understanding, care, and patience, and the Karens love them, pamper them, and treat the babies like pet puppies. The children ride them as American children would ride a Newfoundland dog.

An elephant is best trained by one mahout, with the assistance of many attendants. Frequently a mahout will make it his lifetime task to be the keeper of that particular elephant. The head of a wild calf is fitted into the narrow end of a V-shaped wooden stock. A strap is fastened under the belly, lifting a portion of the weight off the feet, and another fits across the back. The elephant is starved for 24 hours and receives its first food from the hand of the trainer. It is caressed and petted each time it is fed, until a bond of affection is established between master and beast.

When the calf is thoroughly aware that the man is its friend, the mahout makes a gentle approach toward sitting on its head. As soon as this is successful the straps are removed one at a time. It may take weeks. Next step is to take the calf for a walk between several coolies armed with long spears. It must not be forgotten that a four-year-old elephant on the rampage can be a deadly adversary. Besides, the elephant is an investment which can be lost through one curt word.

The slow process of teaching the commands is now undertaken and requires six months to a year or more. The commands in Siamese are as follows:

MEP—to kneel
YA—to stop when working
MAH LOOM—to lift or turn over
SIGH—to lift a leg for hobble
TOH—to push end downhill
PEH-AR—to push over easy
SUNG—to let mahout get up by lifting leg
MAH YAK—to lift
SUK—come back
NIM—steady
HOW—in conjunction with another word, meaning steady or stop
QUAN CHANG—is the term to indicate elephant rider or mahout
CHANG—is elephant

The remarkable intelligence of the elephant and its love of work reduce the need for urging, and the mahouts use vocal commands to a minor extent only. The name of a cow elephant always has the prefix *Me* or *Meh*, while the males have the prefix *Poo*. A bull with one tusk would be called *Poo Ek;* one who had lost his tusks would be *Poo Sedaw*. *Meh Koot* would be a female with a short tail, and so on.

Both male and female elephants have tusks, but those of the bull are longer and heavier. Tusks are frequently broken while working, and sometimes they develop infected cavities and must be extracted. When badly splintered they are sawed off; but one tusk is better than none, and the elephant makes frequent use of this unusual tool.

The bulls have a tiny hole over the eye, which periodically becomes swollen, at which time a "must" or "oil falling" takes place. A healthy male

► SPOKEN COMMANDS are rarely given, though the elephant understands a number of them as described in the text. Pressure of the foot behind the ear and shifting of the weight of the mahout, or trainer, guide the animal in the performance of its tasks. The elephant is affectionate towards his master and responds to kind treatment. The natives, in turn, are devoted to the huge creatures. A mahout may give his whole life to the care and teaching of a single animal. In many villages white marble shrines honor the elephant god Ganesha, worshipped by the jungle people

[illegible] During this period an otherwise gen- [illegible] loose, he may kill anything in his way.

Lingard recounted an incident which he himself witnessed. An other- [illegible] he made ardent advances but was repulsed. Without further ado he im- [illegible] of them through her, broadside. Having committed his crime of passion, he tore through the jungle clearing a wide path, with the cow still on his tusks. Finally he smacked full speed into a [illegible] teak tree, burying his tusks [illegible] they had to be cut out with an axe! Later, other eyewitnesses verified this almost unbelievable account.

Traveling farther through the dripping jungle, amid ferns that rose higher than our heads and bamboo thickets that grew densely beneath the festoons of thorny creepers hanging from the trees, we ultimately came upon a clearing where another group of elephants were working teak down the stream bed. Occasionally the still air would be split with the roar of a petulant beast whose log had become "hung" on an obstruction. Here I had opportunity to witness an amazing demonstration.

An independent trouble-shooter

It was the responsibility of one ancient tusker to straighten out jams wherever they occurred. A scream from an elephant whose log was jammed between two rocks would bring the old fellow trundling up to the scene, like a wise and patient superintendent. He would take in the situation and then, with a fine application of [illegible] physics would push here or tug there—and the log was free. Trumpeting triumphantly and as though very pleased with himself, he would move along to the next task. Rarely would the mahout give a command.

A small fat calf was particularly amusing. The little fellow was constantly searching for food with his hungry little mouth. Or, while saun- [illegible] ing at whatever object took his fancy [illegible] squirt rocks, his mother, and the squealing mahouts. When the impudent trunk was aimed at me, I retired in haste—to the delight of the ma- [illegible] with glee. [illegible] ing the wetting to get a picture of the little fiend.

We met rough going down the bed of a creek, and gravel filled my tennis shoes until my lacerated feet started bleeding. And as we scrambled through the bamboo thickets, I inspected every stalk before grasping it, because one of the deadliest snakes is identical in color.

Jungle Camp #2 was set in a beautiful forest, with wild foliage pressing in on all sides like a solid wall. Rarely does a breath of air stir on the jungle floor. The sensation of being stifled is made stronger by the muted sounds that are silenced without echo by the absorbent mass of greenery. Wild flowers were everywhere. When the steady downpour of rain gives way to infrequent sunshine, the rising steam from the warm earth brings with it the perfume of green verdure and the exotic scent of tropical flowers.

Here at Camp #2 we treated ourselves to the luxury of a hot bath but pushed on immediately after tiffin. Soon we were ahead of the elephant transport, which averages about two and one-half miles an hour. Making a short cut through some rice paddies, I noticed that the bullocks which were plowing had appendages from five to eight inches long and two inches in diameter hanging from their stomachs and chests. I asked what they were and was told they were leeches. Did they ever attack human beings? Oh, yes! One got them while wading in the streams where they breed in the tepid water. The bullock is a gentle pet to the natives. But to a white it can be one of the most ferocious animals. It is fast, tricky, and armed with wide sharp horns. I saw a man on the operating table in Chiengmai who had been gored by one in a thorough and workmanlike fashion.

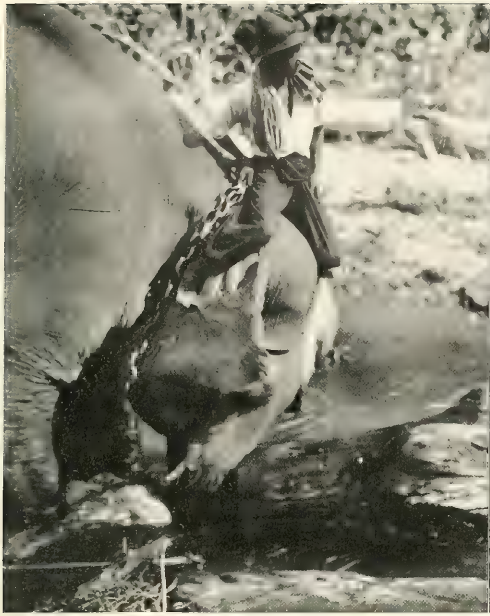
Back at the Wat, we felt almost at home. A clear starlit sky and cool breeze created a delightful atmosphere. A nose flute sounded its soft, petulant note far away, as some amorous squire courted a Siamese maiden. Through the evening could be heard the booming of drums calling the priests to worship. Their sound rippled like a wave through the jungle. At first far away one could hear a faint sound like an echo. Other Wats picked up the call, moving closer until—*Boom!* the eighteen-foot drum in our Wat would let go, causing me to [illegible] out of my skin. I think this was partly horseplay; the youthful bonzes were outdoing themselves to impress us.

The bad boy of the herd

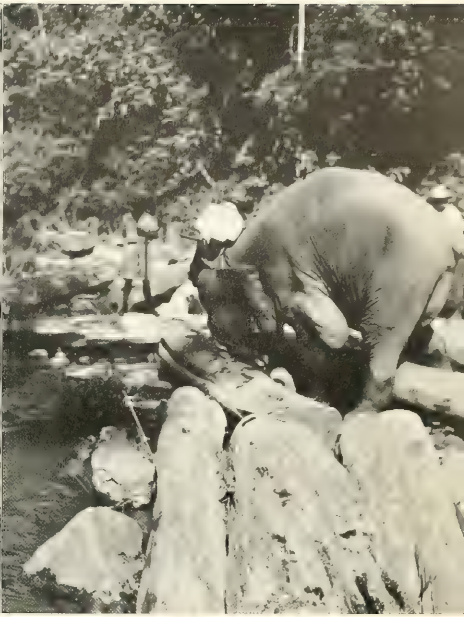
When we departed the next morning we had a [illegible] with an exasperating little tusker, who didn't seem to want us to mount our ponies. With a bellow he charged playfully. But a ton of elephant charging is not funny. Shouting and waving our sun helmets, we managed to drive him off. We walked fully 200 yards before attempting to mount again, and glanced back just in time to see him coming again in a mad rush, as fast as a horse on a dead gallop, with ears out and trunk up. Again Lingard stopped him with my futile assistance.

This time we hiked a long distance before attempting to mount. The same youngster had been quite a pest around camp, butting the ponies and raising Cain in general. While we were eating, his inquisitive trunk would come wavering over our dinner table, and he would single out something to reach for. Lingard would then administer a sound whack on the trunk with his fork, and the petted creature would assume as hurt a look as a young elephant can.

We arrived back in Lampang cut by thorns and covered with mud, but with a record of the elephants at work. Photographically I had met with incalculable difficulties. I did not know there could be so much water. The first night out my exposure meter and wrist watch rusted tight. When I reached into my "watertight" case for filters, they fell apart in my hands. The film became so swollen with moisture that I could hardly slide it through the pack. Some of the pictures are blurred because of the wide open lens and slow speeds which I was forced to use in the darkness of the forest. But it is an honest record. It gives a true impression of the estimable teak elephant going about his daily tasks—tasks that make the ballyhooed tricks of a circus elephant look like calf's play.



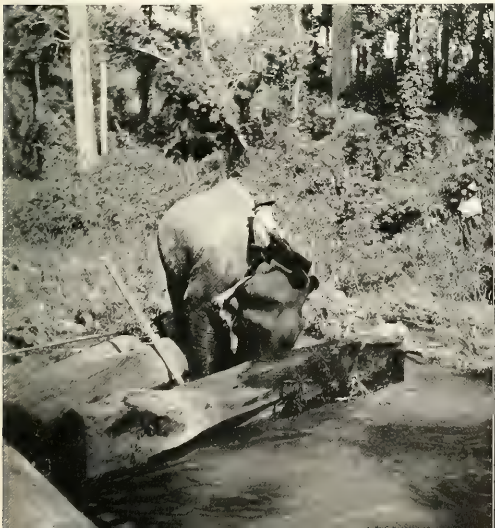
▲ **THE MAHOUT** hangs onto a chain encircling the elephant's neck

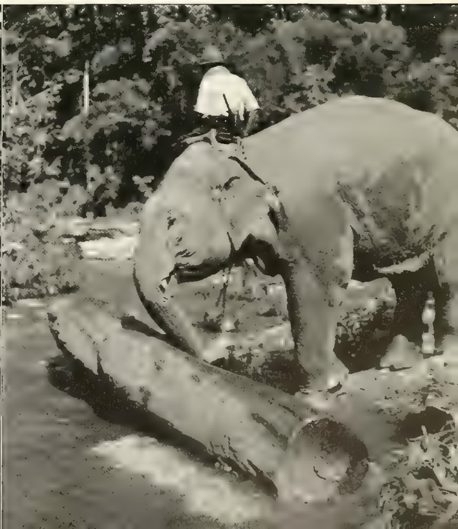


▲ . . . **AND KEEPS HIS PERCH** like an acrobat

▼ **THE ELEPHANT** maneuvers in a narrow space and flexes his powerful muscles to separate the jammed logs

▼ . . . **AND FINALLY** sends the last piece of heavy teak wood splashing into the water





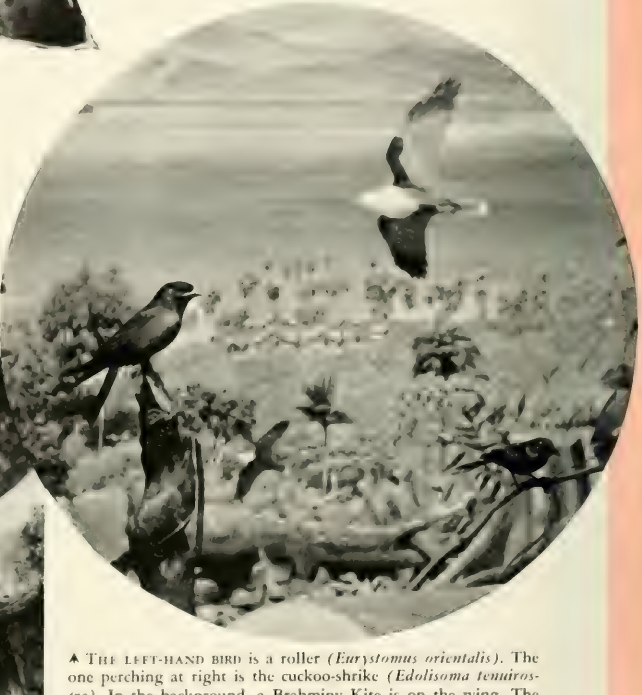
BIRDS O

Science and art combine to portray the bird life of a native garden in a region prominent in the war dispatches from the Solomons.—One of four new bird exhibits recently opened to the public at the American Museum of Natural History

AMNH Photos by Coles

▲ A GIANT SWIFT soars into the jungle clearing which depicts the bird life of the Solomon Islands. The view, which is from Crawford Island, encompasses a native settlement (as shown at right) lying at the foot of a characteristically steep slope. Beyond it, across Marau Sound, lies the Island of Guadalcanal

▼ SCARLET PARROTS, displayed as in life on a vine native to the Solomons

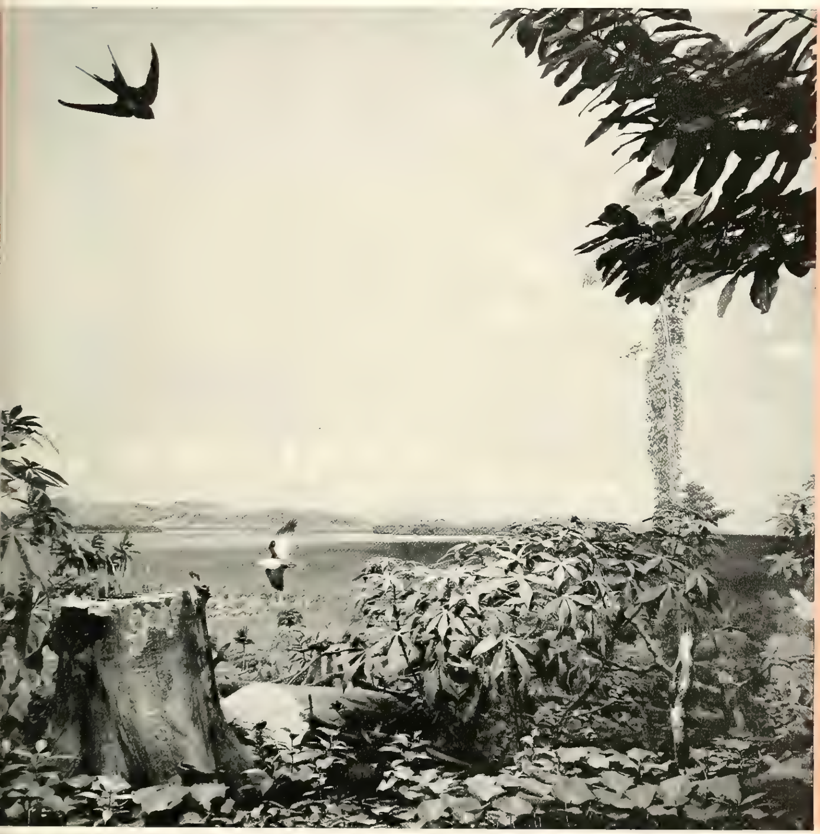


▲ THE LEFT-HAND BIRD is a roller *(Eurystomus orientalis)*. The one perching at right is the cuckoo-shrike *(Edolisoma tenuirostre)*. In the background, a Brahminy Kite is on the wing. The Solomons have remained little affected by civilization, and even today the Melanesians inhabiting some of the islands live in a substantially primitive state. The climate is exceedingly humid, the dry season being shorter than in the islands lying farther from the equator. The exhibit portrays the vegetation as it appears in the month of December.

The group was created by Dr. James L. Clark and his assistants, under the scientific direction of Dr. Robert Cushman Murphy. George E. Petersen, who accompanied the Fahnestocks, made the field studies and prepared the foreground. George Adams was associated with Raymond B. Potter in mounting the birds. Francis Lee Jaques painted the background

GUADALCANAL

THE MATERIAL for four new exhibits in the Whitney Memorial Hall of Birds was collected in large part by Captain John Sheridan Fahnestock and his brother, the late Lieutenant Adam Bruce Fahnestock, who recently lost his life in the service of his country in New Guinea. Prior to the outbreak of war the young explorers cruised the Pacific in the "Director II" but lost their vessel at the Great Barrier Reef in Australia in 1940. Fortunately they had already shipped their scientific collections safely to the United States. Construction of these new groups was made possible by gifts of Lieutenant Colonel Cornelius Vanderbilt Whitney. The Hall is a memorial to his father, Harry Payne Whitney, and his grandfather, William C. Whitney. It is located on the second floor of the Whitney Wing of the American Museum, which houses the world's largest study collection of birds



▲ THE BUSH FOWL *(center foreground)* lays its eggs in a bed of hot sand or scrapes together a pile of leaves that ferment and produce enough heat to incubate them. When the chicks hatch, they are at once able to fly and fend for themselves. Thus, they never know their own parents. The world's smallest genus of parrots is represented on the upright branch at lower right. This parrot, smaller than a sparrow, climbs trees and lives like a woodpecker. No fewer than 128 different birds are found in the Solomons. The archipelago is particularly interesting for the clear-cut way it demonstrates principles in the distribution and evolution of species

KNOW YOUR *Christmas* TREES

By HARRY L. SPOONER

Its life is a short but a merry one, for like some of the big merry-makers, the Christmas tree lasts a scant seven days. But in spite of its short life, there is nothing else in the Christmas festivities that contributes such a powerful influence as the Christmas tree. No matter how elaborate the other features of the Christmas merry-making are, they all revolve about the Christmas tree as the central feature.

During the Yuletide every street and every avenue is transformed into a fairy isle by colored lights decorating the traditional evergreen. The pageant is repeated inside mansion and hovel with equal spirit, as the sparkling trees blaze forth the message of the season. The decorated Christmas tree has become a symbol in many parts of the world and is an important part of the Christmas celebration in almost every American home. Fifty years ago our trees were trimmed with red apples

HOW TO CHOOSE A

TRUE FIR

THE BALSAM FIR has a beautiful pyramidal shape, fairly rigid branches, and lustrous dark-green needles that do not fall as quickly as others

DOUGLAS FIR

THE DOUGLAS FIR is a fine tree of pyramidal form, with nicely spaced branches. It is easily the most popular Christmas tree on the West Coast

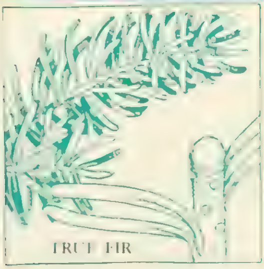
SPRUCE

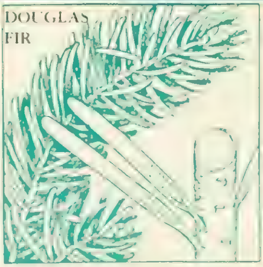
SPRUCES make admirable Christmas trees. The crown is dense and pyramidal. They provide about 25% of all the Christmas trees used in America

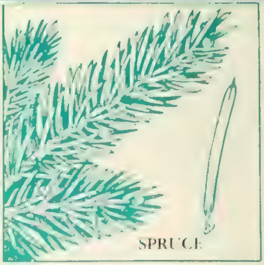
The central spike on these three is erect and strong enough to hold an ornament

HOW TO TELL THEM

If the needles grow singly on the branch, the tree is one of these fo







If the needles feel SOFT when you grab them, it is a true fir or a Douglas fir

If the needles feel PRICKLY when you grab a handful, it is a spruce

IF you pluck a needle and it leaves a CONSPICUOUS ROUND SCAR, the tree is a true fir. About half of all our Christmas trees are balsam firs

IF you pluck a needle and it leaves an INCONSPICUOUS OVAL SCAR, it is a Douglas fir. The buds on the ends of the branches are sharp-pointed

THE NEEDLES are usually four-sided and grow from a small woody base protruding from the branch. They are stiff and usually have a pointed tip and popcorn. Today a vast industry supplies factory-made ornaments.

As you read this, about twelve million trees, neatly bundled according to size and variety, are moving toward the hearths of America, and in the rush to get a good tree, the American housewife may well want to know more about them.

Practically all coniferous evergreens can be used for Christmas trees, but some are better than others. Most popular are the firs and spruces. Next in order are the pines and cedars. Accessibility is frequently the deciding factor. For instance, in Colorado, where fir is abundant but grows at high altitudes, making it difficult to get out, the lodgepole pine and the Douglas fir, growing at lower elevations, are more frequently used.

The balsam fir comprises probably half of all Christmas trees used. There are several reasons for this. The tree has a beautiful pyramidal shape and its fairly rigid branches are well adapted to supporting lights and decorations. Its lustrous, dark-green needles do not fall as quickly as those of other species. It has a spicy odor not found in other evergreens. And finally, it bundles tightly for shipment. This is a very important consideration, as the reduced bulk lowers shipping costs. On taking off the strings, the trees spring back into normal shape almost at once. The bulk of the balsam firs come from the northeastern and Lake states and Canada.

In the South the Fraser fir is used to some extent. Since it grows only on the high mountain tops of North Carolina and Tennessee, however, it is so difficult to get out that its use is limited. Likewise the Rocky Mountain states have plenty of fir but it grows so high as not to be readily accessible. It therefore gives way to lodgepole pine, Douglas fir and to some extent to Englemann spruce. On the Pacific coast the Douglas fir is principally used.

Spruces—black, red, and white—make up about one-fourth of the Christmas trees used. Black and red spruces are used commonly in the New England states, south to the region of Philadelphia. In Illinois and Ohio the demand for Christmas trees is partially met by nursery-grown Norway spruces.

Where firs and spruces are not readily available or are too high in price, the pines are used. Throughout Maryland, Virginia, and in Washington, D. C., the scrub pine is almost the only local species available for Christmas trees.

Such species as northern white pine, southern pine, hemlock, red and white cedar, and redwood are used locally to some extent. The flexible, drooping

HRISTMAS TREE

HEMLOCK

Hemlocks have flat needles of a dark green color that give a beautiful lacy effect. But their flexible branches make them better for wreaths

PINE

Pines make suitable Christmas trees where better adapted evergreens are not available. Their artistic charm is in their very long needles

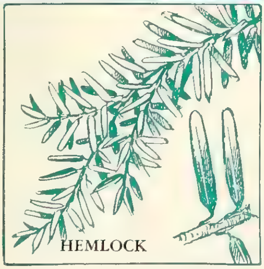
CEDAR

Cedars used locally as Christmas trees depart somewhat from the traditional form but hold their foliage much longer than some other evergreens

The central spike on these three is apt to be droopy or inconspicuous

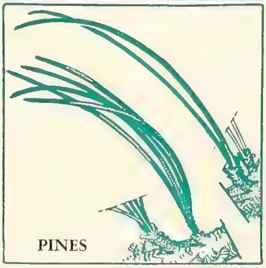
Y THEIR NEEDLES

Drawings by Laurence Blair



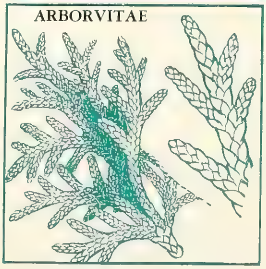
If the needles are short, fairly soft, and twisted at the base, the tree is a hemlock. The needles are generally blunt and are thrown into a two-ranked arrangement by the twisting of the leaf-stalks. The branchlets are usually slender and drooping

If the needles grow in bunches of two to five, it is a pine



Many different pines grow in North America, and the needles of all but one (in the arid Southwest) grow in bundles. Pines are used where firs and spruces are not handy. Lodgepole pine, for instance, is used under such circumstances in the Rockies

If the needles are scalelike, it is probably one of the "cedars"



Once recognized, the scalelike foliage of the arborvitae is not apt to be mistaken. Arborvitae and other "cedars" are used locally, as for example the incense cedar in California and the northern white cedar *(Chamaecyparis thyoides)* in the East [illegible] Christmas [illegible] However [illegible]

[illegible] tent commercially in New York and Philadelphia. The fir has a delightful fragrance, and its flat leaves remain on the tree for a longer time than the needle-leaves of other trees. [illegible] states where other evergreens do not grow. It is often used, in fact, in Tennessee and Pennsylvania although other trees can be secured. In California it is not rare to find incense cedar and redwood used as Christmas trees.

In the eastern states the trees are as a general rule owned by farmers, who sell them to cutters on the stump. In Wisconsin, Michigan, Minnesota, and Canada they are usually cut from lands owned by lumber companies—sometimes without their consent or knowledge. During the past few years, a considerable number of trees have been cut from national and state forests as part of their thinning operations. Of approximately two million trees cut in Minnesota, between 400,- [illegible] come from the state forests.

The center of the Christmas tree trade is in the big cities of the East. New York City and the New England states consume several million trees annually, a considerable portion of the total output. Christmas trees are cut and sold according to size.

[illegible] Christmas trees for shipping begins as early as August. Table trees are often cut during this month and placed in cold storage warehouses until the shipping season comes. The cutting of larger trees starts in September and not later than October. The housewife will readily see that the life of a Christmas tree in the home depends largely upon the heat to which it is subjected.

Crews of from two to fifty men are selected for the cutting, depending upon the area. In many places, Indians are employed in this work, as they are expert woodmen. A camp is established near the center of production—frequently a lumber camp is used—, and the crew is usually divided into gangs, each gang doing a certain part of the work. One gang consists of the cutters, who go ahead equipped with hand saws for table trees or axes for the larger ones, which are generally sawed off clean later. One slash of a sharp axe is usually sufficient for the experienced cutter to cut all but the largest trees. He also trims the trees, cutting out any dead, broken, or straggling branches or those where the squirrels have eaten off the tender tops. He leaves the trees where they are cut.

Another gang follows up, dragging the trees to an open space. Here the butts are sawed off and the trees are tied in bundles. The tiers straddle the bundles, thus pinioning them with their legs, and tie them with strong rope. In some of the larger camps, the trees are laid on wooden horses and in that position tied in bundles.

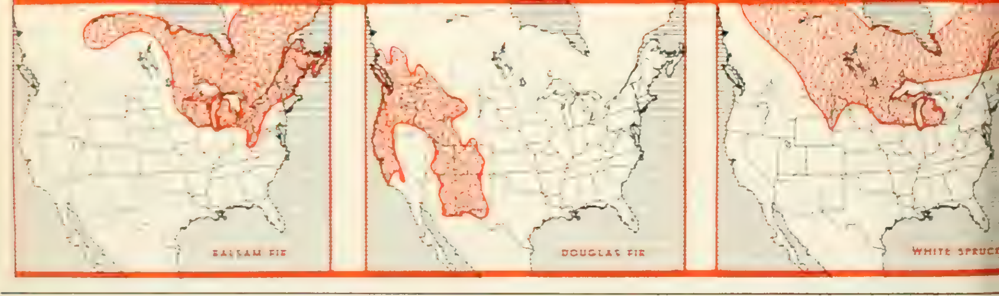
The bundles are piled up like cord wood. If the location is not adjacent to a road, they are "skidded" out to where they can be reached by truck or sleigh. If they can be conveniently left, they may not be taken out of the woods until time to ship. For the most part, however, they are hauled out of the woods on trucks, sleighs, or "drays" to the nearest railroad siding. Here they are piled up to await shipment. Where trees are taken from a wet swamp, a wide tracked caterpillar tractor and a steel boat or "dray" is used to get the trees to a truck road. On high land, horses or trucks are used.

The weather must be considered all through the season. The trees must be cut before hard freezing weather. If frozen, the cutters must hit several times instead of once to make the cut, thus losing valuable time. It is dangerous, also, as the axe can easily glance and injure the user. When frozen, the limbs are very brittle and will break as the tree falls, thus making the tree "lopsided" and unfit for sale. On the other hand, the trees must be removed from the woods before deep snows come, or they will be lost.

The shipping, in box cars or on flat cars, usually begins by November 15th. Trucks are used for the shorter hauls, a 3-ton truck carrying about 600 trees of average size piled high and securely tied. Box cars, which convey about one-third of the trees, can accommodate from 3000 trees to as many as 20,000 of the smallest sizes.

With so many trees being cut each

WHERE CHRISTMA



BALSAM FIR seldom thrives as an ornamental. But the handsome white fir will grow from seed and is widely used from Va. north into New England

SMALL DOUGLAS FIRS are hardy and attractive for ornamental planting in the northern, northeastern, and western states. Consult your nurseryman

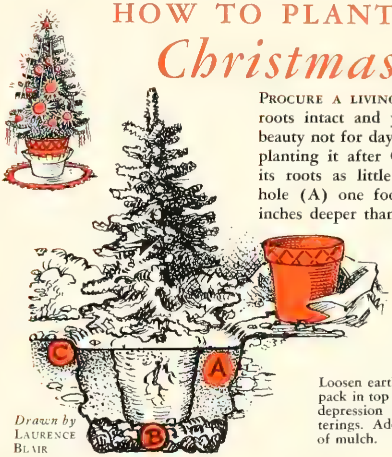
NORWAY SPRUCE, adaptable to eastern conditions, is a favorite. A northern exposure and moist, clay loam are advised. Or try white spruce year, the question of the depletion of the supply often arises. If all trees on any one plot were cut, there might be some danger of this. However, with good forestry practice, the number is likely to increase rather than to diminish. The proper cutting of small trees for Christmas use is not a menace to the forest, but on the contrary it is a means of improving the forest. By good forestry methods, the smaller trees are thinned out to give the larger ones a chance to grow into merchantable timber for lumber. As many thousands of small trees start out on an acre of land and only 500 to 700 will grow into large trees, it is a distinct saving to cut the remaining trees while they are small.

The Government Forest Service strongly condemns the practice of cutting trees promiscuously from places where their removal would mar the scenic beauty or where a valuable young forest is destroyed by cutting all the trees for quantity shipments. Trees cut under Forest Service supervision are marked with red tags upon which is printed: "This tree was cut in the —National Forest under the direction of the United States Forest Service for the improvement of the forest stand." On the reverse side is printed: "The prevention of forest fires through the past years has made possible this tree to decorate your home." A number of states have also printed certificates for properly cut Christmas trees. Insistence by the purchaser, either through certificate or reliable information, that a tree was cut in accordance with good forestry practice will help to discourage destructive cutting.

The state of Minnesota, which began in time to save much of its valuable timber, could double the present cutting without danger of depletion. Some private owners also attach tags to their trees to show that the cutting was not damaging. One of these tags reads as follows: "Greetings from the White Mountains of New Hampshire. This tree brings a Christmas message from the great outdoors. This cutting was not destructive. Forest Products Association, Inc., Groveton, N. H."

With the scientific methods of cutting now used, there will be plenty of Christmas trees for coming generations despite the fact that it takes five years for the average tree to reach a marketable height. But there is of course nothing to prevent one from growing one's own Christmas tree or using one with the roots intact and planting it after the Christmas season is past. Indeed, there is every reason both sentimental and practical in favor of this. The Christmas tree is an important symbol of our civilization, and it has a great life, while it lasts. If you plant it on your land, you will enjoy it that much longer.

HOW TO PLANT YOUR *Christmas Tree*

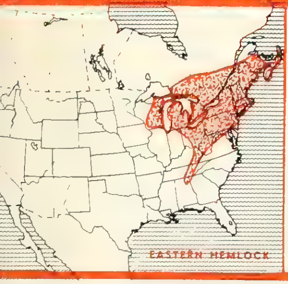


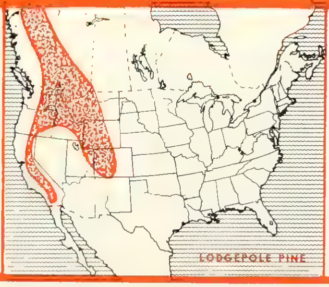
Procure a living evergreen with roots intact and you can enjoy its beauty not for days but for years. In planting it after Christmas, disturb its roots as little as possible. Dig hole (A) one foot wider and two inches deeper than the ball of roots

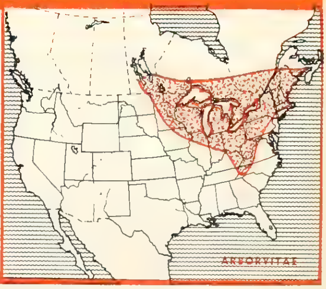
Loosen earth at bottom (B), and pack in top soil leaving two-inch depression (C) for regular waterings. Add generous covering of mulch.

Drawn by Laurence Blair

REES GROW







Eastern hemlock ranks high among ornamental conifers. In the early years it grows slowly but is nevertheless good for borders and backgrounds

Western pine grows fast; eastern white pine thrives beyond its natural range and is our most widely planted tree. Both are strong and handsome

The trim, decorative arborvitae is frequently cultivated, either from cuttings or transplanted seedlings. Your nurseryman will give details

ALUMINUM

By Frederick H. Pough

[illegible]

ALUMINUM [illegible] strategic list, [illegible] back to the critical list. Yet it was the first metal on which formal priorities were invoked and the first substance for which a scrap collection campaign was instituted. It seems to belong on the strategic list. Certainly it will be of the greatest importance for the next few years, and for a time a considerable proportion of the ore we need will have to be imported.

Aluminum is one of the commonest elements. It is estimated that 7.3% of the earth's crust is aluminum, only oxygen and silicon being more abundant. The trouble is that these two other elements are usually combined with the aluminum in the form of a very hard mineral that is difficult to separate. The rock-making mineral group known as feldspar contains a considerable proportion of aluminum and is far more common even than our last strategic mineral, quartz.

There are many, many aluminum minerals, but only one that is used as an ore on a large scale. This is called bauxite, after the place in France where it was first discovered in 1821, Les Baux. Like a number of other minerals on the strategic list, it is the ore that is strategic, not the finished product, for we must import the ore, whereas we process it in this country. Also, there are several other uses for bauxite, some of which are as essential as the refined aluminum is for airplanes, as will be shown later. They consume 25 to 30% of the total tonnage.

Bauxite is not a single substance entitled to full rank as a mineral, like cassiterite or quartz. It is, rather, a mixture of minerals, hydrates of alumina. The minerals of this group occur as complex intergrowths, and it is difficult or impossible to separate them. More specifically they are known as gibbsite (with 35% water), boehmite and diaspore (both with 15% water). Generally, any given ore is a mixture, and there are usually other colloidal alumina-water mixtures with them. Naturally, bauxite is not an attractive looking ore, and [illegible] masses of light reddish brown, claylike material. However, they sometimes [illegible] small beanlike masses all cemented together, in which [illegible] structure.

The origin of aluminum ore is very different from that of the other strategic ores we have discussed—different, indeed, from almost any other ore you might mention. Previously we have spoken of ore veins and magmatic differentiates, processes that imply igneous activity and mineral-rich waters emanating from hot centers. Aluminum ores did not form from such solutions, but from other rocks, by atmospheric weathering. They are very widespread, and it seems strange that anything so extensive could be strategic. But the fact remains that the United States and our ally Russia both have apparent shortages of workable aluminum ore.

The atmospheric weathering that produces bauxite deposits is not the normal type of weathering which can easily be seen wherever exposure to the elements has changed the color and composition of a rock surface. Analyses of the soils formed by this process in the United States show very few [illegible] bauxite; one such was found in southern California. On the other hand, deep residual soils in the tropics have often been found to contain bauxite. The indication is, therefore, that bauxite cannot form in ordinary temperate climates but does so under tropical conditions of weathering.

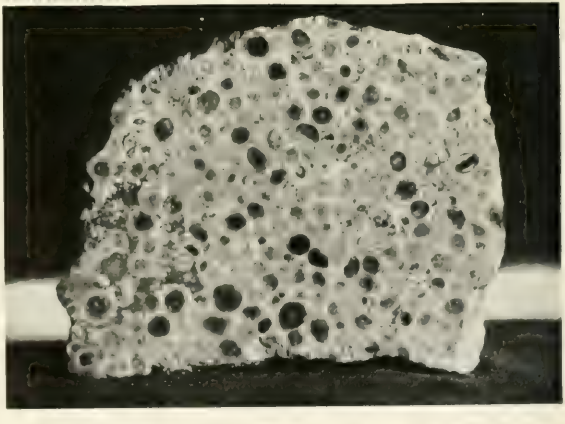
The rocks from which bauxite is formed are commonly clays or an igneous rock poor in silica known as nepheline syenite. For an ordinary residual clay to become a bauxite deposit, some solvent action must remove the silica normally present, leaving behind the alumina. If the iron oxide is removed as well, so much the better; the ore will then be purer. Such deposits are known as laterites, from the Latin word *later*, meaning a brick, and they are sometimes a source of iron as well.

It has been seriously suggested that the explanation of bauxite formation might lie in the occurrence of frequent tropical thunder showers, causing nitric acid to accumulate in the soil where it could attack the silica. This is not a very likely theory, however.

It is immediately noticed that all

◄SYNTHETIC RUBY. Delicate instruments pivot on bearings made from this aluminum compound. Non-metallic uses (refractory bricks, abrasives, cements, etc.) take 25% to 30% of the ore

ALUMINUM is derived from claylike material that reveals none of the metallic luster we admire in the glittering body of an airplane. The most interesting specimens show many small beanlike masses all cemented together ▼



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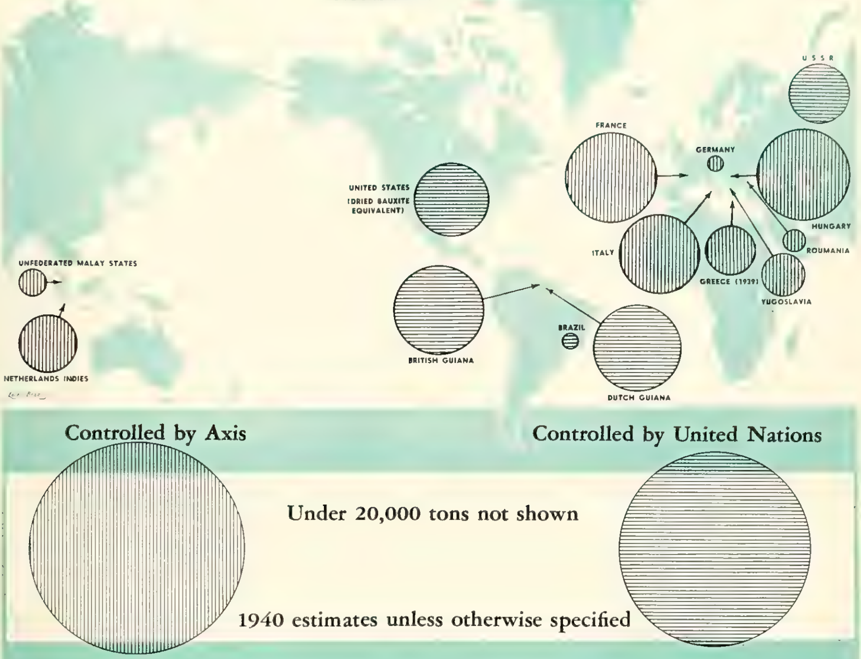
STRATEGIC METALS

NUMBER X


U S S R
FRANCE
GERMANY
UNITED STATES (DRIED BAUXITE EQUIVALENT)
HUNGARY
ROUMANIA
ITALY
GREECE (1939)
YUGOSLAVIA
UNFEDERATED MALAY STATES
NETHERLANDS INDIES
BRAZIL
BRITISH GUIANA
DUTCH GUIANA
Controlled by Axis
Controlled by United Nations
Under 20,000 tons not shown
1940 estimates unless otherwise specified

Production of Bauxite

bauxite deposits do not occur in the tropics. In fact, none of the important Axis supplies do, with the exception of the deposits recently captured by the Japanese in the Netherlands East Indies. The Axis out-produces us, or did until recently, and all of their ores come from the temperate regions—France, Jugoslavia, Hungary, Rumania, and Greece. Some of these, at least, are residual deposits, like our own in Arkansas and Georgia which formed in an earlier geological time, when the climate was warmer in regions where it is now temperate and when tropical weathering was taking place in Arkansas. For some of the European deposits, entirely different methods of formation have been suggested, such as the reaction of solutions bearing aluminum sulphate upon limestone.

Attention must be called to one additional requirement for the formation of a bauxite laterite. It must not be carried away by subsequent erosion and deposited where it cannot be found. In this country, for instance, laterites that were formed in the Cretaceous and Tertiary periods have been eroded and distributed as sedimentary deposits. A vast area that might otherwise be considered suitable for bauxite on a basis of the underlying rocks is eliminated by the former presence of glaciers. No bauxite deposits are possible in the north where the intense scouring action of the glaciers has removed all unconsolidated weathered material. In the relatively short interval since the last slow retreat of the ice, the climate has not been propitious for a bauxite deposit to form there. Even now, we may be in what is merely an interglacial stage. For these reasons, we have to look to the south for our bauxite.

Production of aluminum in the world has increased rapidly in a very short time. The name comes from the old Roman term *alumen,* applied to any substance with an astringent taste; hence our word alum for potassium aluminum sulphate, originally applied in the Middle Ages. Alum was supposed to contain a metallic substance, whose oxide received the name alumina. Sir Humphrey Davy proposed the name aluminum for the metal, though he did not find it, and this name was accepted later. It subsequently became aluminium to the British and in most of the chemical textbooks, but Americans generally still adhere to the old form.

Finally, in 1827, Wöhler succeeded

[illegible] expensive, however, for general use. At about that time Charles M. Hall in this country and Paul Héroult in France, working quite independently and without knowledge of each other's work, discovered an electrolytic process for recovery of aluminum. This reduced the cost of aluminum considerably to a very low figure, which has steadily fallen to its present price of 15c.

Hall's process, which is in use today, was developed from Bunsen's successful experiments in the electrolytic production of aluminum in 1830. Aluminum chloride was mixed with common salt, and an electric current was passed through the mixture. Chlorine escaped as a gas and the aluminum collected in small drops. The modern process uses cryolite (sodium-aluminum fluoride) as the solvent, which is less volatile than the chlorides and has a low melting point. When molten, it easily dissolves alumina. The cryolite is placed in a carbon-lined furnace, in which carbon electrodes are placed. A current is passed through them into the lining, melting the cryolite. When the latter is liquid, the electrodes are raised and alumina is added. The current breaks up the compound, and the oxygen combines with the electrodes, burning them away, while the heavier metallic aluminum sinks to the bottom as a liquid and is drawn off from time to time. The process is a continuous one, the electrodes being replaced as they burn away and fresh alumina added. Theoretically no cryolite is consumed, but actually a small amount of it is used up, and this is replaced. Cryolite might well be a strategic mineral, since all of it is imported from Greenland, where it occurs in a unique pegmatitic deposit, but it can also be synthesized from fluorspar, of which we have a more adequate supply.

The Hall process requires tremendous amounts of cheap electric power, 8000 to 20,000 amperes being used in the operation of the furnace. This requirement limits the amount of aluminum that can be produced as rigidly as does an adequate ore supply. However, new power projects in this country, notably the Tennessee Valley power and the Grand Coulee Dam, will be able to apportion considerable amounts of their current to new aluminum plants.

The main uses of aluminum are so obvious that it is hardly necessary to mention them. They largely depend upon its lightness, resistance to corrosion, and strength. For military purposes, only the purest and best quality aluminum can be used, hence much of the scrap is of no military value except in that it releases new production for war use by creating a supply of reclaimed metal for less critical civilian uses. But there are a number of special applications that are of interest. Thermite, the substance that starts an incendiary bomb, is a mixture of aluminum powder and iron oxide. It burns with tremendous heat, owing to the affinity of the aluminum for the oxygen, transforming the mixture into a mass of molten iron and molten aluminum oxide.

Aluminum cements, made from the ore, harden much faster than ordinary cements. Some refractory bricks are made from the ore; and a fusion of bauxite in the electric furnace will produce alumina that is useful as an abrasive. Aluminum oxide is the substance of which rubies and sapphires are made, and the manufacture of synthetic gems is an important use of bauxite. It is strategic in scope because the synthetic stones are used widely for the cutting of bearings for all sorts of instruments. The synthetic gem industry could be a chapter in itself. At the beginning of the war we imported all of our synthetic gems; today we are manufacturing an adequate supply, and after the war, we shall probably make our own synthetics for the jewelry trade. At present all synthetic corundum (aluminum oxide) is going into war industries.

In the 1930's Germany went deliberately to work to build up an aluminum industry, and at the start of the war was producing more aluminum than the United States. Our expansion of the past two years will more than wipe out this deficit, but it is too bad that this could not have taken place a little sooner. Despite the tremendous increase in American production, there will undoubtedly continue to be a wartime civilian shortage of this light metal.

Part of the shortage might be alleviated by the very recent growth of the production of magnesium, a still lighter metal. We have a serious shortage of bauxite ore. About half of it is imported from Surinam, or Dutch Guiana. Our deposits in Mississippi, Georgia, and Alabama are not large or important at present; most of the domestic ore is produced in Arkansas. The production there has been increased, but the deposits are not inexhaustible, and the day is not far off when all our bauxite will be gone. In anticipation of this, several steps are being taken, the most significant of which are experiments in the separation of aluminum from common clays.

Various other minerals have been tried or are being worked as aluminum ores. The Italians have produced aluminum and potassium for some years from leucite, a feldspar-like mineral which is abundant in some of their rocks. In Sweden, experiments have shown that aluminum can be produced from andalusite, an aluminum silicate, and the Norwegians have tried labradorite, a feldspar common in that country. The Japanese have experimented widely with alum shales, alunite, aluminiferous schists, clay, and phosphatic alum. In this country we, too, have worked with alunite, which is a potassium aluminum sulphate, with the idea of obtaining potash, sulphuric acid, and aluminum. Large deposits of it are known in the West, and it appears likely that the treatment of this mineral can be made a commercially profitable undertaking.

In summary we can say that the Axis appears to have no aluminum shortage, while we will remain, at least temporarily, dependent upon imported ores. It appears probable that domestic ores other than bauxite will eventually be developed to supply our aluminum needs from deposits within our own borders, so that the prospect is not a gloomy one. We have seen that self-sufficiency in mineral resources is almost possible to the United States, with substitutes available in most cases where the strategic material cannot be obtained at any price.

After we have won the war we can and must make sure that we never again can be forced to fight without sufficient stocks of raw materials to carry us for an extended period. More foresight could have accomplished this now. At the same time, we must also make sure that selfish monopolization of raw materials cannot serve as an excuse for later Hitlers to rise and try to impose an alien political philosophy upon a peace-loving world. While it is wrong to say that this is a war for raw materials, it is certainly true that a maldistribution of raw materials, coupled with a selfish monopolistic control, has served as the base upon which the Fascist pyramid has been erected.

WINTER SLEEP

Mason
WINTER
SUMMER
SPRING

By JOHN ERIC HILL
Drawn by
G. FREDERICK MASON

IN the cooler climates, especially the North Temperate Zone, most mammals remain active all winter, but that is the time of their severest testing and many individuals do not survive the struggle. To remain active an animal must be warm, and even though mammals may be efficiently insulated from loss of heat by their thick fur coats, they must "burn," that is oxidize, large amounts of sugar, fat, and other food elements to produce the heat they require. They must eat more or richer foods, but during the winter there is much less food to be found. Leaves are no longer green; grass is buried under the snow and is dead; insects have died or are hidden under the leaf mold of the forest; and those that feed on small mammals find fewer of them, for they are sheltered under snow and reduced in number by the loss of their food supply.

Birds commonly migrate at this season when food is scarce, but mammals migrate only to a limited extent. Caribou trek from the tundra to the more sheltered forest; the wapiti come down from the mountains, and the animals that prey on them follow. Some mammals store food in caches and remain indoors on the colder days, emerging to feed and play in the warmer spells. And some put on fat, then curl up in a snug retreat, like the woodchuck, and sleep the winter away.

The different mammals that go to sleep in winter do not hibernate to the same degree. The squirrel family, for example, show many stages of winter sleep, from the red squirrel that may stay in his nest for a week of cold weather to the real hibernators, like the woodchuck and the ground squirrels. The chipmunk may stay out until November, but the woodchuck goes into his den much earlier, usually before September.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Fall, 1942.

WEDNESDAYS over WNYC from 3:30 to 3:45 P. M.

Science For the Seven Million

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FRIDAYS over the Columbia Broadcasting System from 4:30 to 4:45 P. M.

Exploring Space. Science in the sky.

What happens to a mammal that really hibernates? The body temperature, which is normally about 95° F. or higher, drops to only a few degrees above freezing—to 37° F. in the woodchuck. All of the processes of living are slowed down. Breathing is reduced to about one one-hundredth of the normal rate; the heart beats only seven to ten times a minute; very little oxygen is used by the tissues; and the intestinal movements slow down or cease. The muscles become stiff, much like the stiffness of death. However, warmth, loud noises, or light will disturb most hibernating mammals in a few minutes. Contrary to most expressed opinions, the mammal loses very little fat during the winter sleep.

What causes a mammal to hibernate? Cold, hunger, darkness, and quiet are important factors, but none of these is all-important. They do not cause a mammal to hibernate that does not do so normally.

HOW THEY GOT *their names*

By Roy L. Abbott

Professor of Biology, Iowa State Teachers College

History shows many strange changes in Nature's roll-call

Most of us know that when we eat Welsh rabbit we get cheese instead of rabbit, that the hamburger is not made of ham, and that hot cross buns may be cold, and chili soup hot. But few of us realize what a fascinating hodgepodge of inappropriate names many of our well-known plants and animals carry, or how often when we call them by their right names other people will not know what we are talking about.

Some of our familiar birds, of course, have fine names. No one, surely, will want to quarrel with such clearly descriptive names as bluebird, blackbird, cardinal, or woodpecker, or such obviously imitative ones as flicker, pewee, chickadee, killdeer, or bobwhite. These birds, because of color, voice, or habit, have, in a sense, named themselves.

The erectile feathers on its neck gave the appropriate name "ruffed" grouse to our fine woodland drummer; prairie chicken could hardly be improved upon for the grouse of our central states, although heath hen for the now extinct eastern form was equally good. "Red-tailed" hawk is another fine name, for the bird is red-tailed.

Hundreds of other names are equally appropriate. But coming close to home, those jaunty, brick-dust-breasted fellows which search for worms so commonly on our lawns are not closely related to the English, and original, robins. American robins are thrushes, as readily may be seen from the speckled breasts of the young ones, a feature common in greater or lesser degree to all young thrushes.

In the case of our "turtledove," which properly should be called "mourning dove," two mistakes have occurred. It is not the same bird as the smaller European species for which it was named, nor should the name "turtle" be applied to it. The Latins called the European form *turtur* because of its soft voice, and this was corrupted by our ancestors into "turtle." The fact that this misrendering of the word has been carried over into the English Bible has caused much confusion. For in the Song of Solomon we read that "the voice of the turtle was heard in our land," and this, to the devout but uninformed, can mean only the vocalizing of the reptile of that name.

Our orioles turn out to be blackbirds. True orioles (a group of birds related to the crows) are not found in North America. Our Baltimore oriole should have been just "Baltimore bird," as Catesby called it in 1731. The Baltimore part is correct, for the bird's gold and black match the colors of Lord Baltimore, for whom it was named. Also we discover that our warblers are different from the European birds of that name. Nor does the name "Bohemian" tagged to our beautiful waxwing fit very well, for this species was not derived from central Europe as its name implies. Still less fitting is the name "turkey" for our fine Thanksgiving bird. The turkey really hails from Mexico but had to be carried to Europe by the Spaniards to acquire the wrong name by which we know it.

Our habit of piling name on name is illustrated by our great brown cat, the American puma or cougar, which the early colonists called "panther," the old Greek name for leopard. The Yankee woodsmen soon corrupted this name to "painter," and this splendid animal now bears the additional names of "catamount" and "mountain lion." The birds, however, bear off the palm for multiplicity of common names. The coot or mud hen, for example, is known under 24 different names, and the name "coot" is also applied to half a dozen other species as well. Sixty-five different hunters in various parts of the United States could each shoot a ruddy duck and each rightfully call it by a different name. But the flicker really captures first prize, for it is known by at least 127 vernacular names.

The plant-namers have not been less active. East of the Mississippi and north of the Ohio, 15,000 common names have been distributed among only 4000 plants. Though the French were in Canada and the Spanish in Mexico years before the coming of the English, most of our names for native plants and animals are of English origin. And since language is not made by the educated but by the common people, the majority of our conspicuous birds and mammals and plants were named by men who were often careless with words and usually ignorant of zoology and botany. We may say that theirs was an honest ignorance, for what with Indians to fight and a raw country to subdue, they had little time to bother about getting the strange plants they saw or the animals that ran or flew about them into their proper groups. They simply had to have names for these things, so if an animal or plant looked like one they were already familiar with back home, they called it by the name they knew, often adding the term "wild" to distinguish it. This simple method readily disposed of dozens of species, of which wild ginger, wild oats, wild goose, and wild pigeon are commonplace examples. False indigo and false strawberry are other examples of a long list of plants in which the term "false" distinguished the species from similar forms.

Indian names

If the colonists had never seen the plant or animal in question before coming to this country, they sometimes adopted the Indian name for it. This brought into our language such useful and time-honored names as pecan, persimmon, and chinquapin, as well as woodchuck, moose, skunk, opossum, and raccoon. One might wish that they had followed this plan further. Indian pipe, Indian potatoes, and Indian corn are pertinent examples of a hundred or more plant names in which the word Indian appears. This was done, sometimes disparagingly, to indicate plants used by the red men.

More often, however, particularly when compelled to invent a name, they usually called a plant after something that it resembled or after the animal which ate it, such as bloodroot and catnip. Many more plants—all in the Indian doctor's materia medica—got their names from ailments they were supposed to cure or cause; hence ague root, pleurisy root, and ninebark, the last being a sort of cure-all.

Upwards of a hundred plants were rightly or wrongly thought to be bad for animals, such as dogbane, cowbane, henbane, and fleabane. And 70 or more species were named for snakes, none of which, however, had anything to do with snakes except by way of suggestion, say, in appearance.

Strangely enough, of the 65 plants named for the dog, not one of them compliments man's best friend. None of the several dogberries, for example, are edible. Less strange, perhaps, is the fact that those names referring to the hog all express insignificant or disagreeable qualities. Names prefixed by the term "horse" or "bull" usually indicate large or coarse forms, pertinent examples being horseweed, horseradish, bull thistle, bullfrog, and bull-bat.

Sometimes the namers reversed the procedure and named the animal for the plant. Familiar examples of such really appropriate names are woodpecker, cedarbird, tree toad, potato bug, and tomato worm.

In those early days, heaven was seemingly nearer the heads of men than now, and hell much closer to their feet, hence we should not be surprised to find both Satan and the Saints coming in for their share of names. Although not always appropriate, no less than 30 of our common plants carry the name of the devil, familiar examples being the devil's-paintbrush, devil's-club, devil's-horn, and devil's-grandmother. Among the animals, he is remembered in such names as devil-down-head for the nuthatch, devil's-darning-needle for the dragonfly, devil's rear-horse for the praying mantis, and, by implication, hell-diver for the grebe.

All of these animals are harmless to man, and even among the plants, legend has it that those known as "devil's-bites" have their names from the fact that their blunt rootstocks indicate that the devil had bitten them off out of spite for their medicinal qualities.

Among the saints, St. John appears to have been most popular with the namers of plants, for in a list of 96 British plant names, his name occurs sixteen times. It was formerly the practice to name a plant in honor of saints in order to gain their favor. This custom had fallen into disuse about the time of our beginnings as a nation, which accounts for the fact that many such names known in America were imported.

When is a gopher not a gopher?

But we cannot lay all credit or blame to the New Englander. Down in Florida they still call a certain stork an "ibis," in spite of the fact that they do have real ibises there which they call "white curlews." Also they call both a snake and a kind of burrowing tortoise a "gopher," a term applied elsewhere to a small burrowing animal about the size of a mole. Yet with consistent and delightful inaccuracy, the Floridians call their pocket gopher a "salamander" —a cold-blooded creature related to the frogs—and one of their true salamanders, a "congo eel." An eel, of course, is a fish.

And so the [illegible] of calling and [illegible] calling [illegible] goes on. Whenever it [illegible] [illegible] [illegible] although they are not worms. A common little worm found in ponds and creeks is usually called a "horsehair snake," although neither a snake nor an animated hair. And the loud, harsh-voiced cicadas which sound like buzz saws in our trees in summer will probably remain "locusts," although that name is properly applied only to short-horned grasshoppers.

Fishermen call our big-eyed perch, the "wall-eyed pike," the shovel-nosed sturgeon, a "spoon-billed catfish," and any small fish to them, is always a "minnow." Indeed, the common names of fish are so numerous and so chaotic that fishermen in the several states, even though catching the same varieties of fish, hardly speak the same language in talking about them. To remedy this, the American Fisheries Society has set out to standardize the popular names of common fish. If they have their way, the big-mouthed black bass will no longer become a "green trout" when caught south of the Mason and Dixon's line, and the Massachusetts sportsman in Minnesota won't dare say he caught a "horned pout" when it was only a bullhead, or to the southerner, a catfish.

The scientific method

Since 1773 biologists, following the example of Linnaeus, have attempted to escape this multiplicity of common names by giving to each distinct kind of animal or plant a so-called scientific name in Latin or often Latinized Greek. Ideally, a name once given would be the same the world over, and would remain the same. Each animal or plant would have a name composed of two parts, the first part designating the group or genus corresponding, say, to Jones among family names, and the second part being the specific or given name—John, for example. Man's scientific name is *Homo sapiens,* that of the dog is *Canis familiaris.* Scientific names are written in the opposite order from ours, which is quite sensible, for it puts the important part first.

This system not only names things but it groups them as well, for all species under the same genus have the same first name. But it must be admitted that some of these scientific names are badly chosen too; and in spite of the good intentions of the scientists, such names frighten people at first sight, though we unwittingly use some of the hardest ones when we pronounce such tongue-twisters as chrysanthemum and rhododendron. Most of us are being unknowingly scientific when we use such familiar words as asparagus, begonia, magnolia, dahlia, and geranium, for each of these is the first part of the scientific name of the plant mentioned. Some of us, also, may be surprised to learn that fuchsia and magnolia, respectively, to mention only two, honor the memory of Fuchs, a great German botanist, and Magnol, an early French student of our flora. And who does not unhesitatingly say "boa constrictor"—the whole scientific name—when referring to that snake at the circus or zoo?

Jaw-breakers

If we had never known any other names, each of us, perhaps, could use the scientific names as readily as we now use the common ones. But when we come across such a jaw-breaker as ***Citellus tridecemlineatus,*** which is the scientific name of the little thirteen-striped ground squirrel of the central states, many of us will doubtless shake our heads and go right on calling the animal "grinny," "gopher," "flagtail," or "whistling streak," depending largely upon the locality and who saw it last. Indeed, scientific men have often given names to things long before they understood clearly what they were naming. When the Englishman, Robert Hooke, squinting through his crude microscope nearly three centuries ago, first saw the finer make-up of a piece of cork, he called the tiny units composing it "cells," because they looked to him like little rooms, and that name has stuck—possibly because it is short and easy to say—in spite of the fact that every college freshman knows that Hooke was dead wrong. They are not box-like, hollow things at all, at least in animals.

Much the same may be said for that oft-repeated word "vitamins." When first discovered, chemists thought these important substances belonged to a group of known compounds, the amines, and being shown to be necessary to life, they were accordingly called "vita-amines." Yet now that we know that some of them are not amines, we still call them vitamines. The "vita" part, however, is still meaningful, for we cannot live without them.

What are we to do then with our flying foxes which are really bats, with our gar pikes which aren't pikes, and with our glass snakes, which are lizards, and with our bald eagle, which is not bald but merely white-headed?

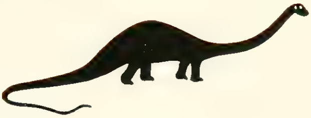
Why, go right on calling them what we have always called them, to be sure. For the average person probably feels toward this idea of calling familiar things by other names than those to which he is accustomed, very much as the Baltimore *Sun* feels toward the campaign to change the speech of the New York school children. It is a "downright useless expenditure of effort; if it succeeded, it would be destructive of color and vitality," says the *Sun.* To pronounce "bird as *boid* and verse as *voise*" . . . is what makes "Brooklyn interesting and stimulating to the rest of the country."

We get along fairly well even if one hunter does call his duck a pintail, while another says his is a "sprigtail" or a "spiketail," and it does give color, freedom, and variety to our speech. Must we change Buffalo Bill to "Bison Bill" because that great hunter never slew a buffalo in his life, but only bison?

When is a thrush not a thrush? When it is a Louisiana water thrush, a true wood warbler, answers the scientist. But for most of us, it will remain a water thrush for all that, just as our big red-breasted thrushes will continue to be robins. Scientists will eventually agree upon one scientific name for each life form, and many of the common names which have not been much used will gradually be dropped from the records, as they should be. But great numbers of them, even though they do not fit, are here to stay.

Hence, for most of us, when we go for a stroll, the dogtooth violets will be just that and none the less attractive in spite of the fact that they are not violets but lilies; and the New England aster for many will still be the "last rose of summer." Mountain ashes and prickly ashes will remain so, even though they are not ashes, and our calla lily will still be lovely and still a lily though really it is a close relative of the jack-in-the-pulpit. The orioles or hangnests will be no duller of color though they actually be cousins of the blackbirds. The poison oak will irritate our skins just as effectively though it be poison sumac, poison ash, or what you will! Most of us, too, will see no contradiction in terms when we say we saw some yellow or white violets, or that blackberries are red when they are "green"—meaning, of course, unripe.

THE DI-PLOD́-O-CUS



Perhaps the poor Di-plod'-o-cus
  Should not bear all the blame;
He had no chance to spare himself
  So difficult a name!

Yet, since he stood fourteen feet high,
  And more than eighty long,
Some other names for him could sound
  Embarrassingly wrong.

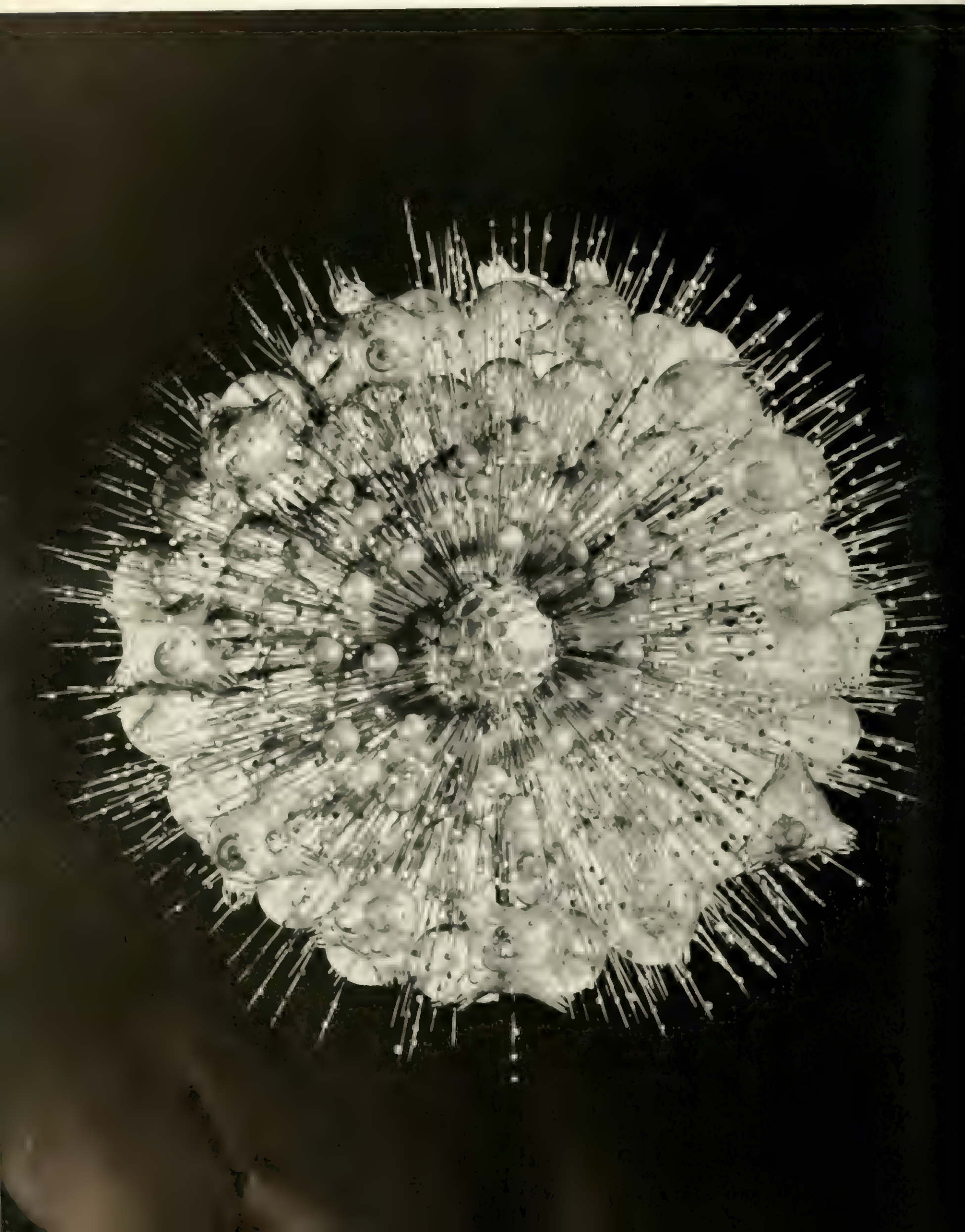
His legs were tall, his body short,
  His tail too long and fat;
Upon a neck nine yards in length,
  His head was small and flat.

And so it probably was best,
  And saved a lot of fuss,
To give the creature, as they did,
  The name, Diplodocus.

(P. S.: Since there was more than one
  Such prehistoric whopper,
To speak of Di-plo-doc'-i-dae
  Is altogether proper.)

— MAUD MERO DOOLITTLE.

▼ A MINUTE SEA-CREATURE (*Trypanosphaera regina*) one of the Radiolaria. These tiny animals construct a skeleton of natural glass from the silicon dissolved in sea water. The nucleus, which directs the life-activities of the creature, is contained within the latticed sphere in the center. The photograph is of a glass model representing the animal highly magnified, constructed by Herman Mueller, the Museum's skillful glass-modeler



Universe Through a Microscope

The *Protozoa*

By Roy Waldo Miner

Curator of Living Invertebrates,
The American Museum of Natural History

Tiny creatures that swarm by the million in water everywhere. A world invisible to the naked eye but of great importance to mankind

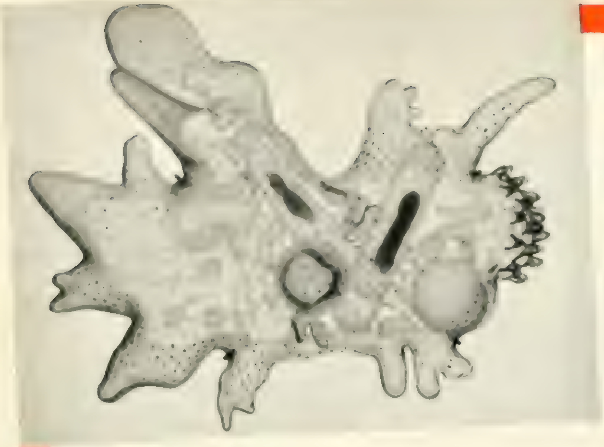
Photographs by Charles H. Coles, *American Museum*

In this world of struggle between millions of human beings, it is hard to realize that, invisible to our eyes, another world composed of billions of organisms is pulsing with complicated life activities in our very midst and carrying on a struggle that has continued through eons of time since long before man, or, in fact, all other animal life, came into existence. The invention of the microscope, three centuries and a half ago, created a window through which the great naturalists of that time were able to peer into this universe of minute creatures hitherto totally unsuspected by mankind.

Conspicuous in this microscopic life are the teeming Protozoa. With their minute bodies consisting of but a single cell, they were among Nature's first experiments in animal life. Yet the ancient trial was a success, for they still live and penetrate all the zones of existence. They inhabit the earth from the equator to the arctic regions, from the highest mountain tops to the deepest abysses of the ocean. Wherever there is moisture they exist, and, in their resting stages, they bide their time in desert places. They swarm over aquatic vegetation and multiply in pond and stream. They float in the open ocean by myriads

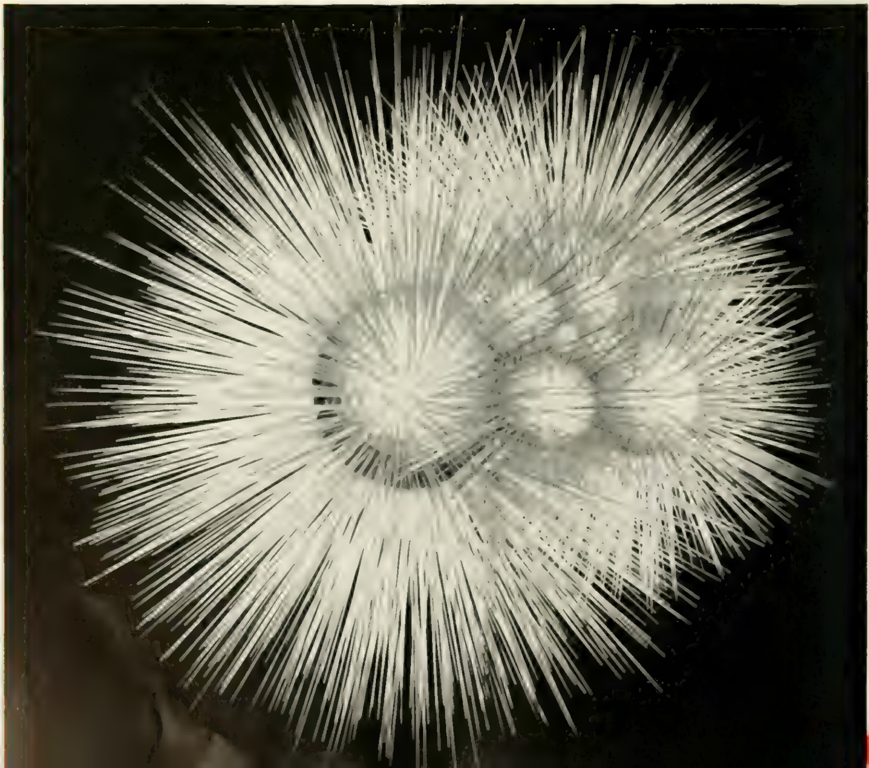
▲ **Looking through** the microscope into an otherwise invisible world, Doctor Miner selects the tiny creatures from which greatly enlarged models are to be constructed in glass for the American Museum's exhibit of Protozoa. Each animal must be carefully studied and drawn before this is possible. Skilled artists are used for this purpose

◀ **Herman Mueller**, the Museum's wizard in glass, exercises his remarkable skill in modeling countless delicate structures over a hot flame to produce his wonderful protozoan models

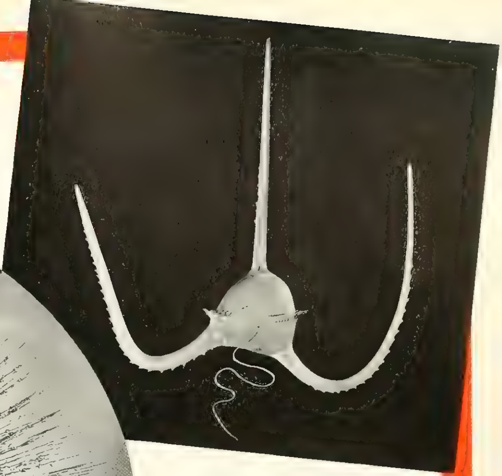


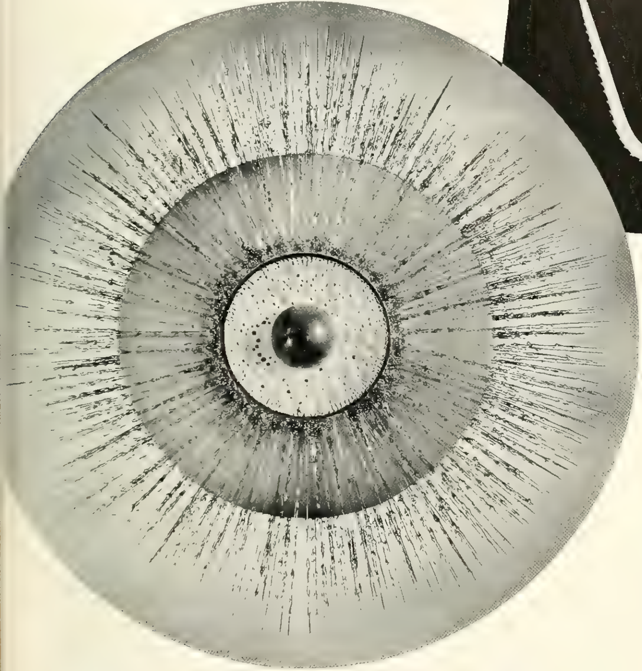
◀ ONE OF THE SIMPLEST of all living animals, the microscopic single-celled *Amoeba* resembles an irregular mass of living jelly, moving about by extending finger-like projections of its substance and flowing into them. The round nucleus is visible near the center of the body. A bubble-like "contractile vacuole" at the right is about to expel detritus into the surrounding water. This model, like the others, is of glass and represents the animal highly magnified. The *Amoeba* is common in fresh water

▼ UNLIKE the related naked *Amoeba,* the *Globigerina* builds a many-chambered shell of limestone. These creatures are so numerous, floating in the open sea, that, when they die, their shells gradually accumulate on the sea bottom, forming beds miles in extent. These often solidify into rock. Geologic changes may elevate them above the surface to form limestone cliffs like those of Dover, England. Thousands of related species are known, which build shells in great variety of pattern. Many are fossilized, and among them are certain species found only in oil-bearing rocks, so they are of importance to oil geologists as aids in locating oil deposits. Note the great number of delicate needle-like bodies that had to be set carefully in position on this model



➤ **The protozoan** *Ceratium,* with its peculiarly shaped glassy shell, is particularly abundant in tropic seas, where, at night, the luminescent bodies of these tiny creatures cause the sea to glow in the foaming wake of moving vessels, or when the water is disturbed by oars





▲ This beautiful creature is among the simplest of the Radiolaria. Whereas most species of the group are equipped with glassy shells, the *Actissa princeps* is shell-less. The spherical nucleus is centrally located within the membrane of the central capsule, while threadlike pseudopodia ("false feet") extend in all directions to secure food

and their fossil shells form the substance of continental rocks. Finally, they penetrate the tissues of all other animal life and gain their livelihood in the intestines and blood stream of the highest animals, including man. While carrying on this part of their career some feast upon man's very tissues and organs, causing many of the most serious of his diseases and culminating in epidemics more fatal than war. Who knows but that Nature's first life experiment may well be her last and that the legions of primitive one-celled creatures that achieved the earliest steps in evolution may finally triumph over the boastful race that fondly imagines it has achieved the summit of evolution, namely, Man himself?

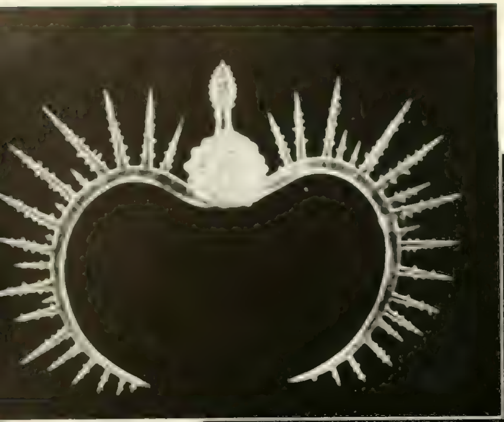
The Protozoa are spoken of as *single-celled animals.* That is, their entire bodies are equivalent in size and living substance to one of the millions of microscopic cells that make up the tissues constituting the organs of our bodies. But there the resemblance ends. For each protozoon is a complete and independent animal, performing within its minute single cell all of the functions that require our entire cellular complex to accomplish.

Within the protoplasm enclosed by its cell boundaries, the protozoon provides for sensation, locomotion, feeding, digestion, assimilation, growth, breathing, excretion, and reproduction. Our enormous equipment of cells is made up of specialized individuals arranged in tissues, which, in turn, are grouped in organs, each with a special function. A muscle cell can do nothing but contract. A digestive cell can only secrete. A nerve cell can only transmit sensory or motor impulses, and so on, all other functions being lost or reduced.

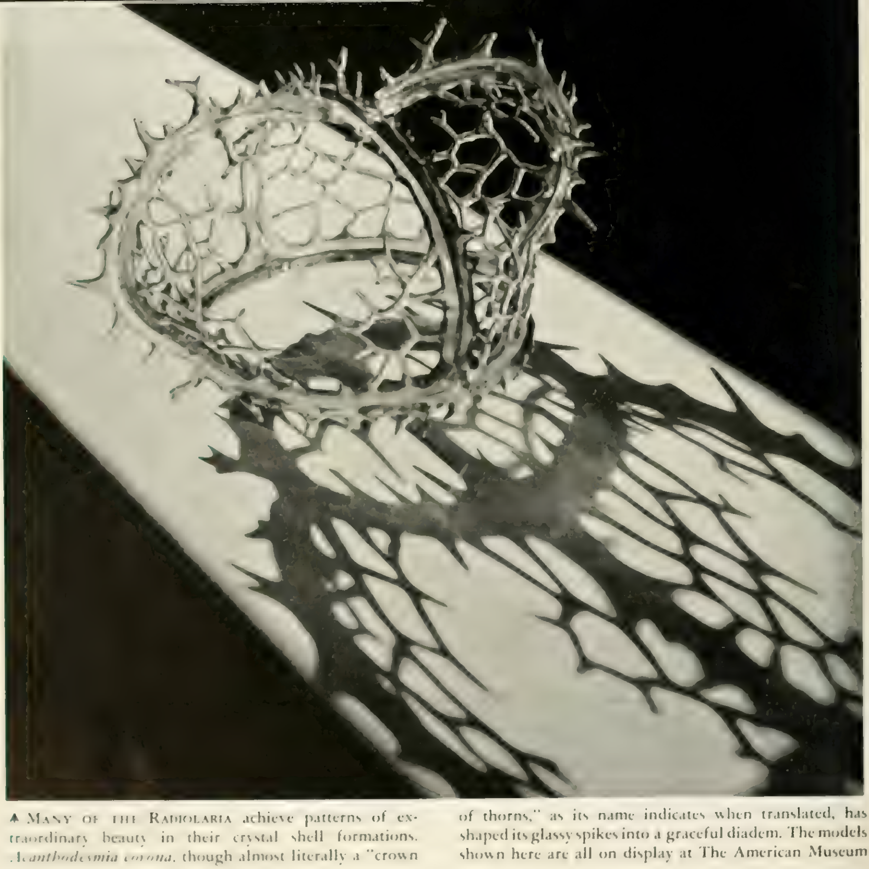
A cell is thus a living protoplasmic entity. In many-celled animals (Metazoa) it is the living unit of structure, while in single-celled animals (Protozoa) it is the entire living organism. The protoplasmic substance of the cell consists of two main portions, the nucleus and the cytoplasm. The former is a rounded, ovoid, or sometimes variously shaped body of greater density than the cytoplasm. It controls the activities of the cell, including the reproductive function. The cytoplasm is the clearer substance composing the rest of the cell, containing various bubble-like vacuoles having to do with digestion and excretion, as well as other inclusions of varied significance to the cell.

The Protozoa are divided into four main groups, which, however, blend at their boundaries through intergrading types, thus showing their fundamental relationship. These are the Rhizopoda, Mastigophora, Sporozoa, and Ciliata.

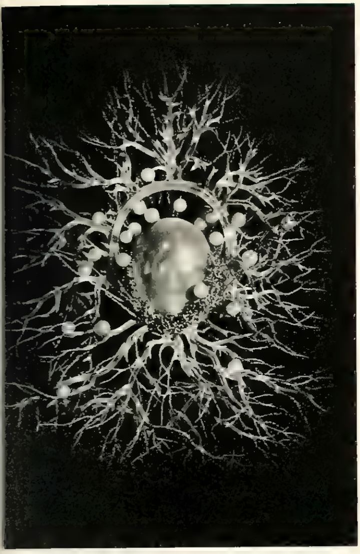
The Rhizopoda have bodies without regular shape from which they extend club-shaped or threadlike portions of their substance and flow into them in order to move from place to place. They also utilize these projections to secure their prey, which they engulf at any part of their body surface. They may be naked or equipped



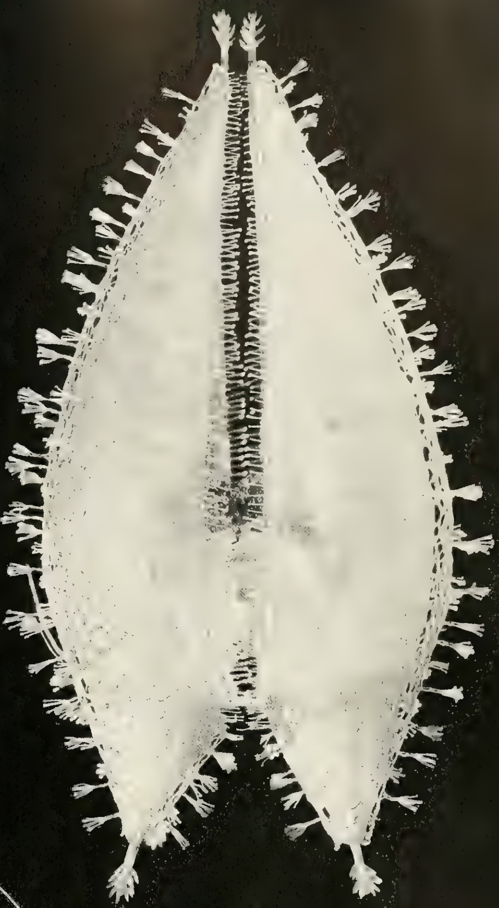
RADIOLARIA produce an almost infinite variety of shell forms. *Dorcadospyris dinoceras*, at left, though a gem of microscopic beauty possesses a pair of menacingly spiked horns, as its scientific name indicates, that would be terrible if borne by some gigantic prehistoric monster. Actually, the creature is only about the size of a sand-grain



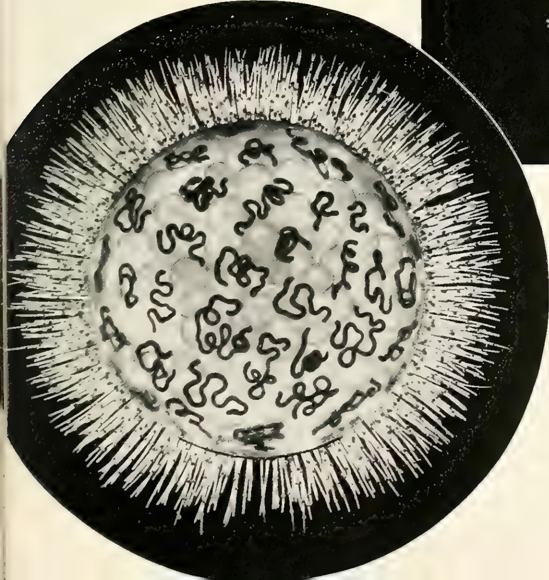
▲ MANY OF THE RADIOLARIA achieve patterns of extraordinary beauty in their crystal shell formations. *Acanthodesmia corona*, though almost literally a "crown of thorns," as its name indicates when translated, has shaped its glassy spikes into a graceful diadem. The models shown here are all on display at The American Museum



▲ THIS is one of the most remarkable of the Radiolaria. *Lithocircus magnificus* has formed a vertical crystal hoop, with branching treelike antlers extending in all directions. The rose-colored central capsule housing the nucleus is seated in this frame, showing a curious cone-shaped structure through its transparent wall

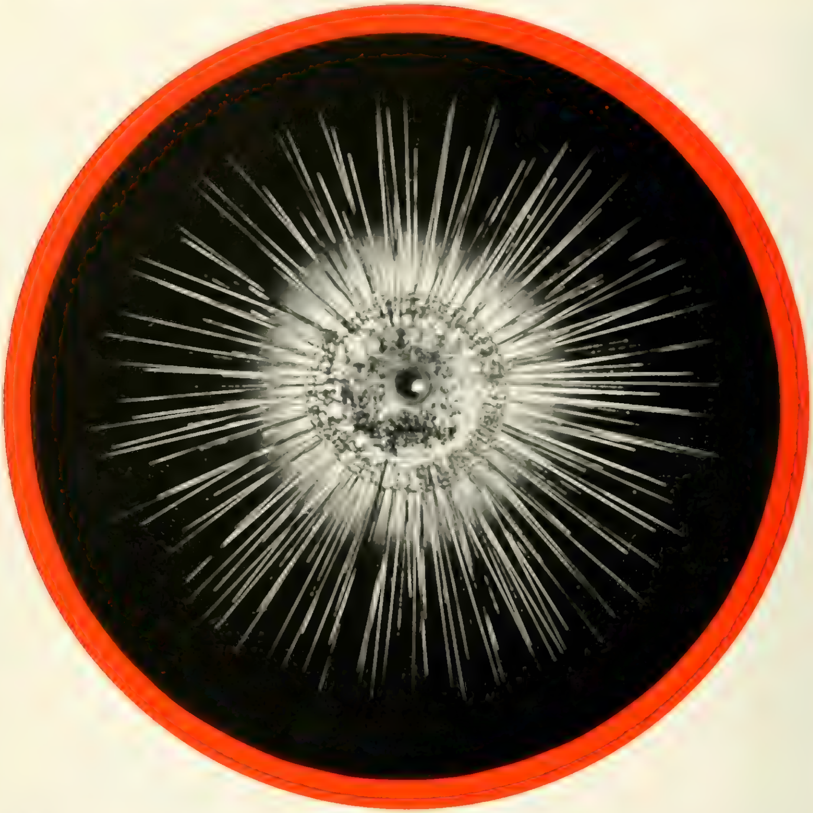


▲ THIS SPECIES *(Coelographis regina)* might well be called the "Queen Radiolarian." It is one of the most highly specialized forms of the group. Between its graceful mitre-like shells is enclosed a complicated central capsule with branching tubelike structures, while the outer surface is a delicately wrought mosaic of lace-work. Incidentally, this is a triumph of glass-modeling technique, being one of the most difficult of Herman Mueller's achievements



◄ THE SERPENTINE RADIOLARIAN *(Collozoum serpentinum)* is a colonial species, made up of many individuals, each with a scarlet, serpent-like nucleus. They surround a central bubble-like mass from which the protoplasmic filaments of the colonial pseudopodia project in all directions

▼ Though not as large as the Queen Radiolarian, nevertheless the *Aulonia hexagona* is of good size, being [illegible] of an inch in diameter. It is enclosed in an almost perfect sphere of glass lacework made up of multitudes of hexagonal meshes. It is found floating in abundance at the surface in the tropical Atlantic



with shells of either carbonate of lime or silicon. Some of these are simple while others have successive chambers arranged spirally or otherwise. Many show delicate and complex patterns.

The Mastigophora ("whip-bearers") are distinguished by a usually more definite body form, and by one or more flagella, or flexible whips, with which they lash the water and thus move rapidly from place to place. Some form colonies, while others are parasites, causing diseases dangerous to higher animals and man.

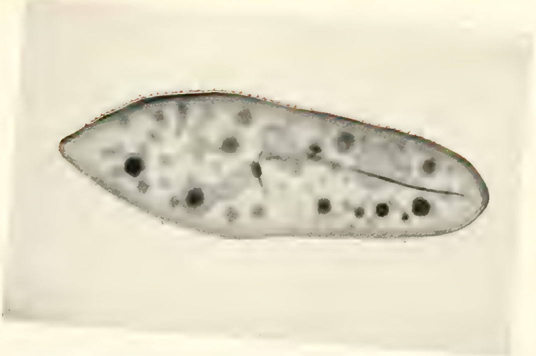
The Sporozoa are internal parasites on larger animals. They are of simple form and reproduce by means of multitudes of spores. Hence the name. [illegible]

The Ciliata are so called because their bodies are covered with numerous closely set cilia, or hairlike projections, much smaller than flagella, but, like them, used for propulsion. They have a more complicated nuclear apparatus and much more specialized structure than the other groups. They are mostly free-swimming organisms and, in certain species, reach a higher degree of unicellular specialization than any other Protozoa.

Each of these four groups has followed its own particular road of evolution, starting with comparatively simple types that show evidences of relationship to the other groups and then evolving more specialized forms peculiar to each group.

Among the displays in the Darwin Hall of the American Museum of Natural History, there is an alcove devoted to the Protozoa, in which may be seen a series of glass models accurately portraying these organisms on a highly magnified scale, beautifully wrought by the Museum's skillful glass modeler, Herman Mueller, under the writer's direction. Outstanding examples of his work are depicted in this article.

Here, some of the most typical Rhizopoda are shown, beginning with the primitive *Amoeba* with its naked irregularly shaped body, through the transparent walls of which may be seen the oval nucleus, the bubble-like contractile vacuoles, the food vacuoles, and other internal features. The Foraminifera have bodies like *Amoeba*, but equipped with protective shells of limestone, the most conspicuous of which (*Globigerina bulloides*) is represented by a beautiful model. This organism floats by the million in the open ocean and, when it dies, its tiny spiral and spiny chambered shell sinks slowly with thousands like it to the sea-bottom, where they accumulate as Globigerina ooze in banks hundreds of feet in thickness and many miles in extent. During past ages, many of these banks have hardened into rock and, in some cases, through geologic changes, have been raised above sea-level to form continental limestone cliffs. The chalk cliffs of Dover, England, were formed in this way.



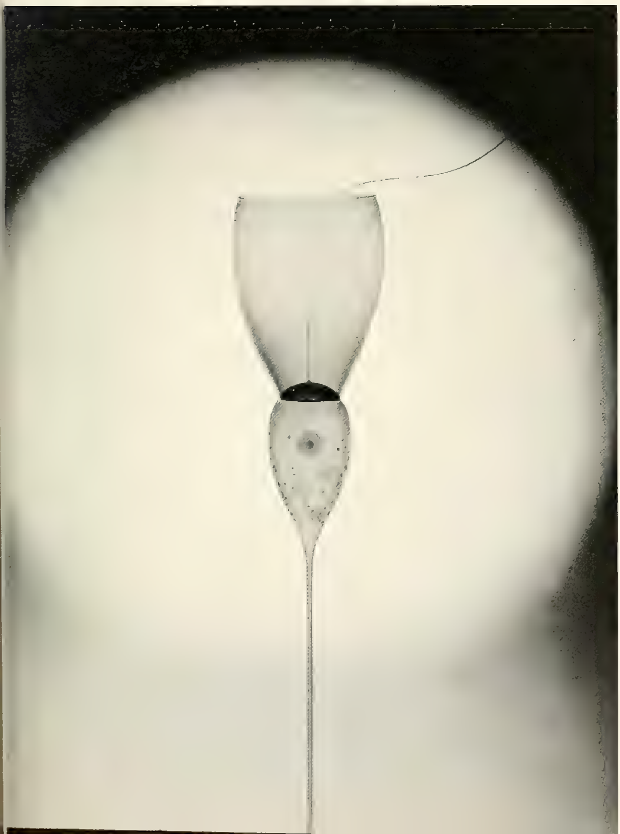
▲ *Paramecium caudatum* is a member of the numerous and specialized ciliate protozoans. Its body is shaped for rapid motion, being propelled by multitudes of tiny hairlike cilia, which cover its surface

Other microscopic marine creatures of tropic seas are the Radiolaria. These manufacture their lattice-like "skeletons" from natural glass, i.e., silicon, with a chemical formula closely akin to that of opal. They are wrought into patterns of unbelievable delicacy and beauty. A fine series of glass models in the alcove exemplifies the intricate variety of these. Like their lime-producing relatives, the glassy skeletons of the Radiolaria are extensively deposited in beds of siliceous ooze on the ocean floor, forming a fine, flinty sand, which, under the name of Barbados earth, is used by jewelers as an abrasive for polishing and grinding precious stones.

The radiolarian animal, like the other rhizopods, extends pseudopodia from all parts of its body, radiating like delicate filaments to form a trap in which other organisms are caught. These are entangled by the filaments, which surround them with protoplasm and draw them toward the central organism, digesting them as they do so. The radiolarians are also complicated in having an oval central capsule within which the nucleus is contained. Foamlike bubbles between the protoplasmic threads have a hydrostatic function, enabling the animal to expand along the radiating bars of its glassy skeleton, thus reducing its specific gravity, so that it rises toward the water-surface, and sinks again upon contracting.

Some of the Radiolaria enter into an extraordinary partnership with tiny globe-shaped organisms belonging to the group Mastigophora, scattered throughout its foamy body. These are yellow in color, due to chlorophyll, which enables them to form their food in the presence of sunlight from carbon dioxide excreted by their animal-feeding partner. In this process, they

▼ THE GOBLET-CELL *(Monosiga gracilis)*: one of the Whip-bearing Protozoa, or Mastigophora. Its long, slender whip is here surrounded by a thin goblet-shaped membrane. The threadlike stalk anchors the creature to the pond bottom



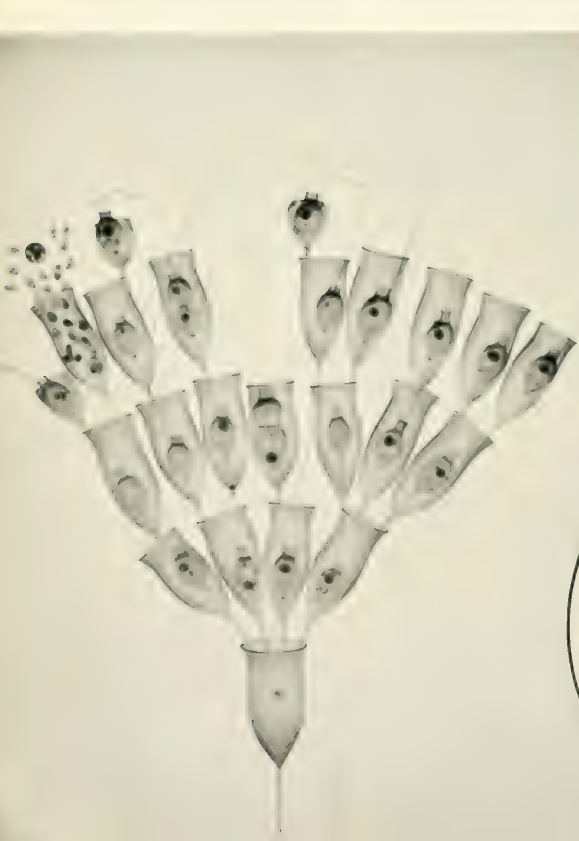
[illegible] is [illegible] by the [illegible].

The Ciliata are found both in fresh and salt water. Unlike the Rhizopoda, they have a definite body form and the outside is covered with [illegible] rows of cilia or small hairlike structures, vibrating in unison, like tiny oars, to drive the creature through the water. In the various species, there is a great variety of shape as shown in the ciliate models in the alcove. One species (*Paramecium caudatum*), familiar to students, is streamlined like a submarine boat and has an equipment of multitudinous moving hairs arranged spirally, so that the animal rotates as it swims. Larger cilia, fused together in groups, line a shallow but gradually deepening trough (cytostome), the cell's equivalent for a mouth, and create a current in the water, which drives smaller protozoans, diatomes, and food-particles generally down through a tubelike "gullet," at the internal end of which a bubble forms to receive it. This "food vacuole," by means of fluid ferments, digests the prey while moving along the streaming currents of the internal protoplasm. Ciliata also have two nuclei, a larger and a smaller one. In many cases, highly specialized structures within the cell (organelles) perform special functions foreshadowing the many-celled organs of higher animals. In fact, some species of this group are considered to be the most highly organized of the Protozoa.

The Mastigophora start off with species of simple organization having changeable amoeboid bodies like those of the Rhizopoda, but, nevertheless, furnished with a whiplike flagellum for propulsion. Most species, however, possess a definite body form without cilia like those of the Ciliata, but with one, two, or several long flagella which propel them through the water.

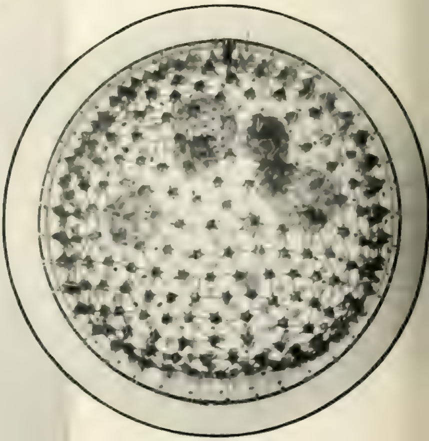
Some have a cytostome ("mouth") at the base of the flagellum, through which small organisms are taken into the interior. Others have no mouth, but, within the body, there are green, brown, or yellow structures equipped with chlorophyll, thus enabling them to obtain their food like plants in the presence of sunlight. This difference in feeding, which, in higher plants and animals, is so clear a distinction between the two great kingdoms, is here a matter of variation in related groups. So that, in this group of one-celled organisms, one may look for the first divergence between the Animal and Plant Kingdoms.

Some of the Mastigophora (Choanoflagellata), possess a delicate, transparent, collar-like structure around the base of the flagellum, which aids in food capture. Such species are often anchored to some object by means of a slender stem and so are stationary. In others, these stems are united to each other so that the individuals form a



◂THE PROGENITOR INDIVIDUAL of this colo
"family tree" (*Stylobryon petiolatum*) has di
leaving its goblet-shaped house behind. Its f
children have anchored their homes on the rim
the parental edifice and may be seen as tiny "c
lared animalcules" through the transparent wa
of their dwellings. To the rims of these, in tu
are attached their offspring of the second gene
tion, which have budded from their own pare
in the manner seen in the "house" of one of th
own companions. A fourth generation has b
added, and a fifth has started. The animal at up
left has suddenly divided into multitudes of spo

▾ *Volvox globator*: a remarkable colony of 1
or more members, described in the text



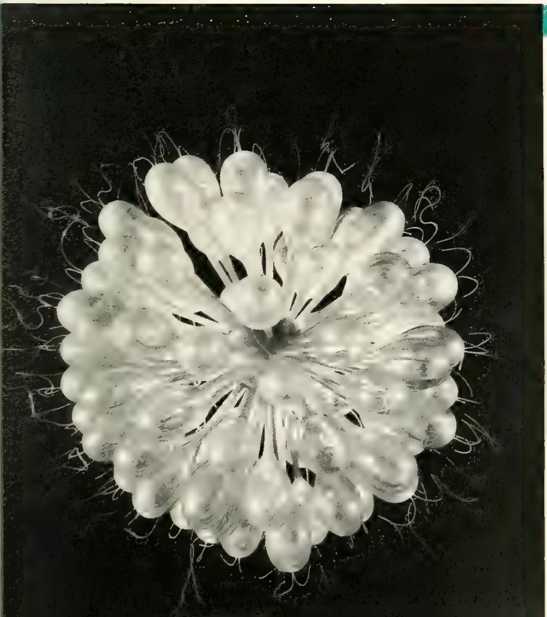
group or colony, which may be either fanlike or united in a spherical cluster of many similar individuals. In the case of the species *Volvox,* there are a thousand or more individuals united to each other by a network of protoplasmic strands around a hollow sphere, each member of the colony possessing two flagella, by the combined motion of which, the colony rotates through the water.

It would be hard to say, at first glance, whether *Volvox* is a colony of single-celled organisms or a single many-celled organism, were it not that the various individuals are capable of existing independently at certain times, while, in many-celled organisms, the cells are dependent upon each other for their existence, being fundamentally specialized structures. Strange to say, there is a foreshadowing of specialization even in *Volvox.* For certain members of the colony become larger than the rest and sink into the interior of the spherical colony, dividing rapidly as they do so, until they form new miniature colonies like that of the parent. Eventually these break through the parent wall and swim away independently. These organisms, therefore, illustrate a method by which many-celled animals and plants may have been evolved from the Protozoa.

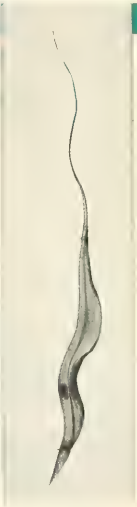
Among the Mastigophora are certain tapering organisms, swimming about by means of an erect "undulating membrane," which inhabit the blood of higher animals and man. These are known as *trypanosomes.* Some of them are apparently harmless, but others devour the blood cells and tissues, causing such diseases as African sleeping sickness. Another flagellate is responsible for the disease known as kala azar. Both of these are fatal to man, while related forms cause great depredations among cattle and other mammals. Protozoans of these groups pass part of their lives in insects and are transmitted to the higher animals by biting or, in some cases, by their excrement.

The group Sporozoa contains greatly simplified protozoans, structurally, reproducing by means of spores. They are usually characterized by complicated life histories. Among them are the dreaded organisms that cause malaria and yellow fever, which take an enormous annual toll of human lives. These last diseases are transmitted only by the bite of certain species of mosquitoes, within whose bodies a part of the sporozoans' life history is passed.

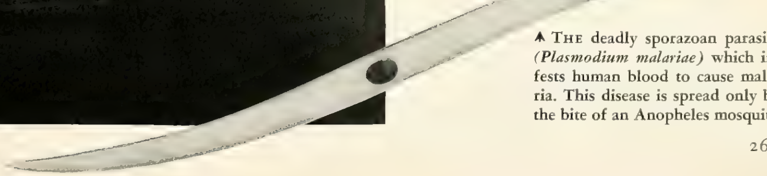
These are but a few instances of the protozoan organisms that must be reckoned with. Though they are so minute as to be invisible to the naked eye, because of that very factor, they are all the more dangerous. Mere size is an unimportant matter where vitality is concerned.



◂ A PROTOZOAN COLONY with individuals joining in a spherical cluster: *Synura uvella.* It is sometimes abundant in fresh water reservoirs in early spring. It secretes an essential oil having a fishy flavor, which, though harmless, alarms people when they taste it in their drinking water at such times



▸ THIS VIRULENT SPECIES *(Trypanosoma gambiense).* during part of its life is parasitic in the human blood, causing the fatal disease known as African sleeping sickness. It is transmitted from one human being to another through the bite of the tsetse fly, within the body of which it passes part of its life history



▴ THE deadly sporazoan parasite *(Plasmodium malariae)* which infests human blood to cause malaria. This disease is spread only by the bite of an Anopheles mosquito

◄ Fuego, the volcano behind Antigua which poured forth lava during the disaster of 1773. Panic raged in the streets of the stricken city, as penitents confessed their sins publicly and thieves hastened to return stolen property. But despite all that the inhabitants suffered, many refused to leave the dangerous spot

► Ruins of the Monastery of San Francisco, largest and richest of the many splendid religious buildings that graced Guatemala's ancient capital

ANTIGUA

treasure house of the past

A catastrophic earthquake which wrecked the city could not destroy the spirit of Spain's New World capital, which survives today as one of the most remarkable relics of a colorful era

By Dorothy Reynolds

Photographs by the author

Few people outside of Guatemala itself have ever heard of Antigua, for it is now only a small town—though one of the most delightful in the world. Set in a charming semi-tropical highland valley, it is surrounded by cool green coffee *fincas* and high purple-blue volcanoes. But two or three centuries ago it was a city gorgeous with the pageantry of church and state, the wealthiest and most splendid between Mexico and Peru, for it was the capital of the Kingdom of Guatemala, which included all of Central America as well as a large part of southern Mexico.

Not many places in America contain so many reminders of the past as does Antigua, a past that is so integrally a part of the present that you can scarcely draw a line between the two. The town is as packed with treasures as a museum, and yet it has—as no museum and few ruined cities ever do—the charm of the casual mingled with the delight of the unexpected. Poor people live in ancient palaces, markets are held in old convents, tall rows of corn grow in some of the deserted monasteries, and cows and goats graze in the patios of others.

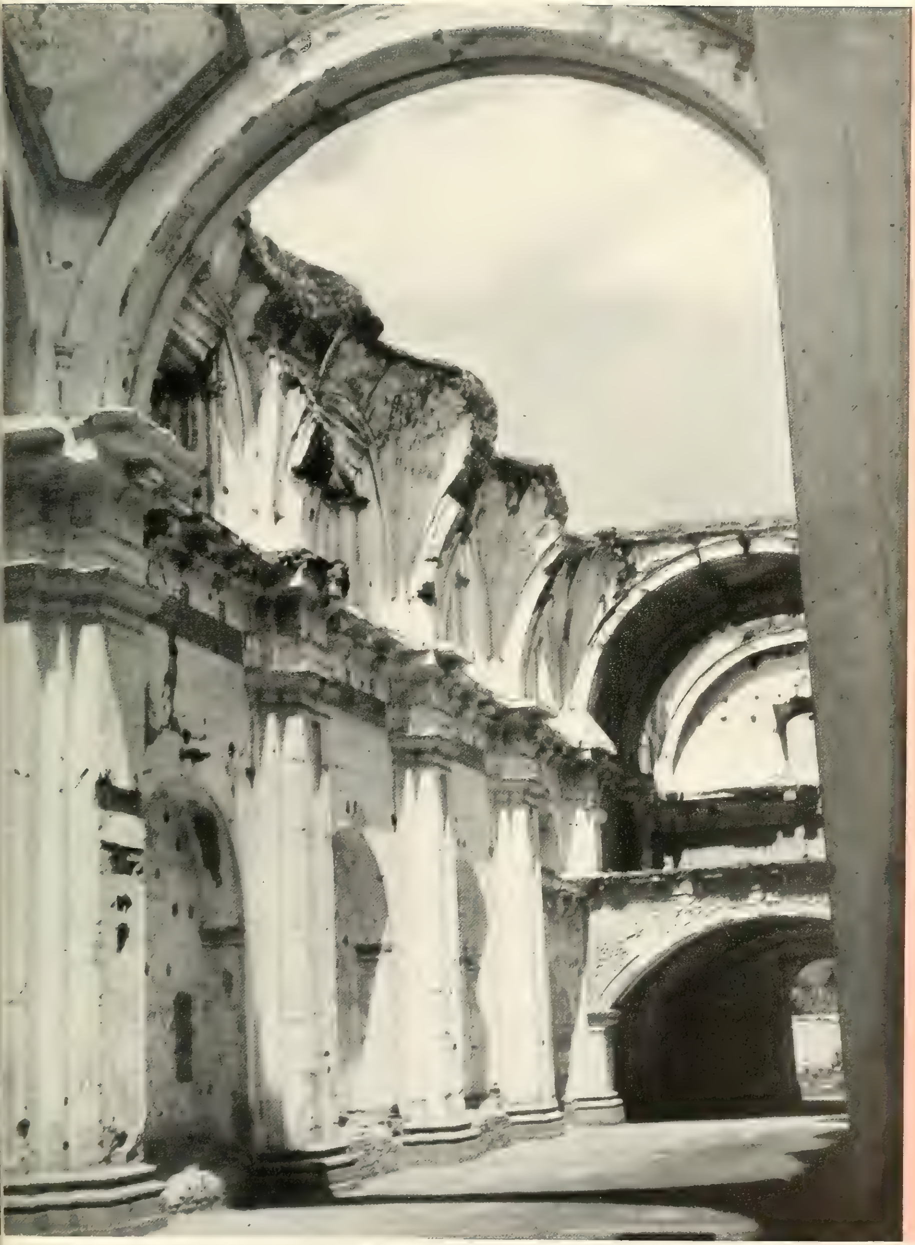
People meet you and casually invite you to "Come see our ruin!" Then, after a breathless half-hour of scrambling through fences and over ditches, of being stung around the ankles by mosquitoes, and having your hands and arms pricked by the sharp nettle-spines of the chichicaste and blistered by the milk-white juice of the *yerba mala*, "the wicked herb," you come upon the remains of some ancient church or convent. Its roof is fallen in and the statues and paintings gone shifted away to that newer and less splendid capital across the mountains, La Nueva Guatemala de la Asuncion (now known simply as Guatemala City), which was founded after the earlier city had been shaken into ruins by a terrifying series of earthquakes.

A city of churches

In Antigua, the remains of old churches can be seen in every block, and they are likewise scattered all through the surrounding *fincas*. Above the cornstalks and coffee bushes rise their creamy white walls, speckled with the shadows of tall *gravilea* trees and enriched by scrolls and fluted columns. Graceful shell-shaped patterns decorate the doorways, and a Virgin or a black Hapsburg eagle may be seen in a niche. Reminiscent of a long-past tragedy, these churches contrast with the lush green peace of the semi-tropics and bring sharply to one's mind grim tales of sudden destruction. Every road leads to a ruin, as does every path and trail. Hunting them out, one by one, you gradually begin to realize how very large the city must have been in the time of its glory. Once it is said to have had 60,000 inhabitants, but today it contains barely a fifth of that number.

"Why did you come when I told you not to," I asked the boy guide who, uninvited, had taken me ruin-hunting, spending a whole sunny afternoon helping me through hedges and guiding me in and out of cornfields and coffee *fincas*. At first I had tried to get rid of him by every means I could think of, but long before the trip was over, I was extremely grateful I had him along to show me where to go.

He pushed his dilapidated hat back on his head till it hung by a single hair, and a charming grin flashed across his glistening brown face. "Because I knew you never would be



ANTIGUA

▲ THE STURDY CROSS in front of the Church of La Merced was one of three that were cast into volcanoes overlooking Antigua to appease the demons inhabiting them. Two were accepted, but this one was hurled back. This church alone survived the earthquake essentially uninjured

▲ THE still stately Palace of the Captains General, facing the flowers and fountains of a delightful plaza. Here in ancient times, nobles looked down while masked Indians danced on *fiesta* days and tournaments were staged by young blue bloods mounted on spirited chargers

able to find them for yourself," he admitted candidly.

In the days when all those buildings were new, the Muy Noble y Muy Leal Ciudad de Santiago de los Caballeros de Goathemala, as it was officially called, was an extremely wealthy and busy city, as well as a very grand one. From sailing vessels at the coast, an unending series of mule trains carried up all the luxuries of the East and the West. Fine Spanish laces and richly woven Chinese brocades and embroidered silks were imported to be fashioned into gowns for the ladies. Gold and silver were brought from the mines of Mexico and Peru, emeralds from Columbia, and coral and pearls from the coast of the Pacific to be made into jewelry.

Homes were furnished with elaborately carved chairs, tables, and cabinets inlaid with mother-of-pearl and silver. On the walls hung tapestries from the best looms of Europe and the Orient and rich paintings made by the great artists of Spain or by Indians under the direction of the friars. Rare pottery from far-off China stood on the tables, and upon the tile or brick floors were spread soft thick rugs from Persia, Syria, and Arabia. Family chapels were as magnificently ornamented, on a smaller scale, as were the public churches, with gold altar-ware, rare paintings and sculpture, hanging lamps of solid silver, and crystal chandeliers. In the workshops of the city, goldsmiths, silversmiths, sculptors, painters, and wood carvers—some of them immigrants from Spain, but most of them trained Indians—worked day and night to carry out the ambitious projects of the proud Guatemalan nobles.

The Capital was full of wealthy merchants, and the whole surrounding valley was occupied by vast *estancias*. On these, as in our own California in its Spanish-colonial days, great herds of cattle were raised mainly for their hides, which were shipped to Spain. Consequently, meat was so cheap that the poorest family could buy a week's supply for only a few cents.

In those days, Antigua must have been like a very great lady—beautiful, proud, and gracious, but a little aloof on account of her own realization of the importance of her position. Now, she resembles a high-born dame who, having suddenly lost her fortune, has settled into the routine of a cheerful middle-class housewife, without any useless regrets for the past but with an unconscious dignity that still gives a hint of the exalted position she once occupied.

The Antigua of today is full of a leisurely, friendly charm. It is a town rich in legends and a good place to relax and dream. It is so quiet there that all sorts of pleasant sounds can be heard, day and night, sounds which in other places are beaten into silence by harsher noises—the singing of birds in the coffee bushes, water splashing, boys whistling down the road, and everywhere the soft, slow ringing of church bells. Those bells were one of the omnipresent sounds in the life of the old city. At brief intervals throughout the day, they pealed forth, one after another in definite succession, first calling the people to morning Mass, then reminding them that it was the hour of the Angelus, and in the evening announcing the last prayers of the day. One street is still known as the Street of the Bells.

Today one hears the frequent tinkle of bicycle bells, which seem like echoes of the campanilla that Hermano Pedro, Antigua's own special holy man, used to keep ringing constantly as he went through the streets urging sinners to repent. But these little bells have none of the harsher tones of the original; like pleasant daytime ghosts out of the past, they suggest only the gentle sadness which should go with all repentance, even that of three centuries ago. And at night one's ears are filled with the pervasive croaking of frogs and the whir of crickets, while big stars shine above the trees.

In Antigua, you can stay at a pension on a coffee plantation, where acres of glossy-leaved shrubs drip with compact clusters of coffee cherries that turn slowly, one by one, from green to red as the season advances. Behind the pension is a sunny patio filled with flowers—tree-tulips, Italian carnations, and tall white hollyhocks, known here by the stately name of Saint Joseph's staff. Yet this plantation is only four blocks from the main public square, today as always the center of the city's life.

This plaza is a delightful park, filled with flowers and tinkling fountains, and surrounded by picturesque arcades. On one side stands the still stately Palace of the Captains General, while the crumbling Cathedral rises on the other.

In Colonial times, the whipping post for recalcitrant Indians and the gallows upon which criminals were put to death were set up in the plaza. Indians staged sham battles and performed dances there on *fiesta* days, while the Spaniards watched and applauded from the windows of surrounding buildings. Members of the nobility were given places of honor on the balcony of the Palace, which was gorgeously decorated with a crimson canopy and hung with colorful banners of Spain and Guatemala and the coat of arms of the capital city (three smoking volcanoes with Santiago on horseback soaring triumphantly above them). There were tournaments, too, in which young nobles took part—gorgeous spectacles straight out of the Middle Ages. Banner decorated tents for the participants were placed round the plaza. One by one, the *caballeros* came out, dressed in suits of bright-colored satin trimmed with gold and silver, their sleeves edged with rare laces and their shoulders covered with capes adorned with gay plumes. Each knight, attended by several lackeys in livery, was mounted upon a spirited horse, whose trappings likewise were rich with gold-fringed velvet and sparkling jewels. During the jousting, music was provided by drums, trumpets, clarinets, and marimbas, and in the evening elaborate fireworks were set off.

▼ The earliest center of higher learning in Central America, founded in 1676: the University of San Carlos in Antigua, now a museum

Ancient costumes used today

Such an impression did the costumes of the nobles make upon the Indians —who must have formed an enthralled, though scarcely noticed, part of the audience—that to this day they copy them in their own favorite dance-drama, *El Baile de la Conquista* (The Dance of the Conquest). The yellow velvet of their short-jacketed suits is made gorgeous with much gold and silver braid, but the sparkling jewels of the Spanish *caballeros* are replaced by tufts of feathers, strings of vari-colored beads, and small round mirrors to catch the glint of the sun.

In the plaza on *fiesta* days, richly dressed lords and ladies mingled with church officials and members of the religious orders in their varied ecclesiastical robes, with Indians in brightly colored regional costumes, soldiers in military uniform, and university professors wearing the colored hoods denoting their specialties. The University of San Carlos is still standing a few blocks away. It is a low, rambling structure with many arches and a graceful fountain in the central patio. Founded in 1676, it was the third-oldest institution of higher learning in America and enjoyed the same rights and privileges as the famous University of Salamanca in Spain. Now the building serves as a museum.

Today, small-boy bootblacks hover continually around the stone seats of the plaza and only the barefoot Indians can walk past unmolested. "Goo' by! Goo' by!" the little fellows greet [illegible] five cents for each shoe!

[illegible] be gallant [illegible] occasion arises, though sometimes their [illegible] "You are very fat!" one told me. I pretended not to hear, reminding myself that the little fellow did not realize [illegible] later he repeated the remark. "You are very fat—and very beautiful!" Only then did I realize that he intended to offer me a compliment. In many subtle ways, the standards of Guatemala are different from our own.

To the north of the plaza stands the Cathedral, once the most important religious edifice in the whole kingdom. Only one chapel is still in condition to serve as a church, and four of the five naves are unroofed, though the fluted pillars and ruined arches that remain are breath-taking in their grandeur. The rest of the [illegible] building—begun in 1543 and worked upon during the next 200 years—was largely destroyed during the earthquake. Even the sepulchre of the Conqueror Alvarado was so completely covered with debris that it has never been found. The church originally had seven entrance doors and was rich with innumerable paintings, much wood carving covered with gold leaf, and splendid marble statues of the Virgin and Apostles.

Religious pageants

Through its portals passed many gorgeous processions. Most impressive of all—according to Father Ximénez, whose description dates from 1722—was that which took place on Holy Friday. Then the officials and social leaders of the city, the priests in their richest vestments, many religious orders, all in their distinctive habits, and the members of the various guilds followed behind the statue of the Cristo Yacente. So numerous were the marchers and the statues of the saints, so solemn the procession, and so severe the dress of the women that, he believes, "It was one of the most devout spectacles offered to humanity."

Ancient Guatemala, like most of the Spanish colonies in America, had [illegible] except by a limited number of skilled artisans. Nearly all the colonists who came over from Spain joined the ranks of the aristocracy. Scarcely less proud than the nobles, in spite of their formal vows of humility, were the incredibly numerous members of religious orders. In the Capital alone, there were 80 churches, most of which possessed adjoining monasteries. There were a few negro slaves, but the lower class was made up almost entirely of humble Indians, who did nearly all the work of the new colony, though they obtained very little of its wealth in return.

The various religious groups were granted vast tracts of land, known as *repartimientos*, and from the produce of these estates—wheat, cattle, sheep, and sugar cane—the monks piled up fantastic wealth and became highly influential. Bitter rivalry caused each order to try to surpass the others in the magnificence of its churches and cloisters, and sometimes quarrels broke out so openly that they had to be quelled by the civil authorities. The convents and monasteries, most of which had originally been thatched adobe buildings, became huge and ornate stone edifices that served as treasure houses for the riches within. Only the daughters of wealthy nobles could afford to enter the convents, for the novices had to bring with them "portions" which usually amounted to between 500 and 1000 gold ducats. Though they were put under strict vows of poverty, each of these girls had one or more serving maids, as well as all sorts of rich and luxurious furnishings to lessen the severity of their cells.

Most notable of all was Doña Juana de Maldonado. Her father, a powerful noble, proud of the beauty and accomplishments of his daughter, who was a talented poet and musician, heaped gifts upon her—pictures, silver lamps, jewel-bedecked statues, and cabinets faced with gold and silver. He even had a special quarter built for her, with rooms and galleries, a private walk, an individual chapel with rich hangings and pictures, gold candlesticks, and a small organ. For attendants she had half a dozen black slave maids. But when the proud noble attempted to have his 20-year-old daughter appointed abbess, it split the city into such bitter factions that civil war threatened, and all the bells were set clamoring at once as a signal of disaster.

In Gage's time, the monastery of the Dominicans, which housed about 100 friars, was one of the richest of all. It included a magnificent church filled with immense columns, gilded arabesques, and cloisters. One of its gardens contained an artificial pool a quarter of a mile long, with paved bottom, where the friars could go boating and fishing for recreation. In the chapel was a life-sized statue of the Virgin made of pure silver, and before the altar hung a silver lamp so large that it required the united efforts of three men to raise it into place.

A lively market

In the neighborhood of this monastery in early times were situated the most exclusive shops and the finest houses. Here, also, was held the daily open-air market, where Indians from neighboring villages sold fruit, herbs, and cacao. The townspeople congregated here to buy Indian dainties, such as *atole* (a sort of corn-meal mush), scalded plantains, cocoa, and puddings made of maize wrapped in banana leaves and containing a bit of fowl or fresh pork well seasoned with biting red chili. The latter were called *anacatemales*, and were doubtless like the small hot tamales, slangily known as "little dogs," which are still a specialty of the region.

After the earthquake, the market left the plaza and moved inside the half-ruined, roofless Jesuit monastery, where it is still held. In the early morning, Indians from the neighboring villages come there with bundles and baskets of fruits and vegetables, flocks of chickens and turkeys, and carrying-crates piled high with pottery jars and dishes.

The cloister of the Capuchins is now occupied by weavers. All day long, in hallways and patios once filled with half-whispered prayers and with the soft swish of robes, men stand today at their primitive foot-looms, flashing the shuttles back and forth with skillful patience, filling in the bright patterns of red, blue, and yellow which border the white cotton fabrics so highly prized by both tourists and Guatemalan housewives.

The "Guatemala City" mentioned so often in old chronicles and diaries is this original settlement, not the shining modern one across the mountains. The latter sprang up after the earthquake caused abandonment of the original capital and left it to be called Antigua, The Ancient One. That was an earthquake which shook the city empty both of its population and its accumulated treasures. The fleeing people carried across the hills even marble statues, ornate carved doorways, stone fountains, and, in some cases, whole houses, which they tore down and transported piecemeal, to be set up again on the other side.

The disaster

From the time of its foundation in 1541, the city had been periodically troubled by earthquakes, but in 1773 a continuous series began which gradually grew worse and worse, until at times men and women had to crawl through the streets on all fours. For days, tiles and stones kept hurtling through the air, and by the time the shocks stopped scarcely a building of importance remained uninjured.

Mass-panic took possession of the people. A monk, seeing the statue of the Virgen de la Luz dancing in its niche, ran crazed through the streets until he fell dead. Priests prayed ceaselessly, and processions of penitents went through the town, lashing themselves and moaning piteously. The days were dark with dust and the nights bright with the streams of flaming lava that flowed down the sides of the nearby Volcán de Fuego. The townspeople, sure that the Last Judgment was close at hand, waited in long queues to tell their sins to the priests, or, despairing of reaching them in time, confessed to one another and ran through the streets crying their derelictions aloud. Enemies begged and granted mutual forgiveness, thieves returned stolen property, and Spaniards who had been shamefully abusing the Indians for years kissed them and publicly begged their pardon.

In spite of everything the inhabitants of the doomed city had endured, when the King of Spain finally ordered the Capital moved across the mountains in 1775, many people did not wish to go, and the officials had to pass all sorts of curious laws to bring about abandonment of the *pueblo*. One prohibited the making of any repairs on the houses. A man could not so much as mend the roof of his own dwelling place to keep out the rain. At last, most of the families left, but a number of the poorer ones remained, making themselves comfortable in the least ruined parts of the buildings abandoned by their owners, even in some cases, in the palaces of nobles and high officials. Strangely enough, Antigua has never since suffered a heavy earthquake, though the newer Guatemala City has had several, one of which shook down a large part of it in 1917.

The Church of La Merced was the only important building of Antigua that passed through the earthquake essentially uninjured. It is still beautiful, with its pale grey façade covered with white arabesques forming graceful frames about the statues in their niches and twining around the pillars like delicate frostwork vines. The sturdy stone cross which stands in front of it bears a curious history.

Early colonists from Spain were much frightened by the numerous active volcanoes in the new country and believed them to be the abodes of ancient pagan demons. So they conceived the idea of baptizing the unholy peaks by casting crosses into their craters. Of the three volcanoes that overlook Antigua, two of them, Augua and Acatenango, submitted peacefully to the ceremony, but the third, Fuego, instead of accepting its cross, flung it back into the very faces of the officiating priests, who thereupon had it brought down to the valley again and set up in front of the Church of La Merced.

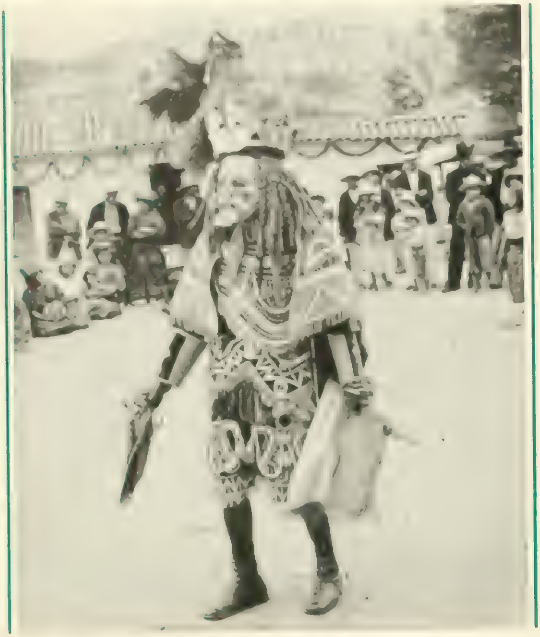
Far larger than the Cathedral was the Monastery of San Francisco, now little more than a pile of ruins in one corner of the town. The pillars and arches, however, are still impressive, even in their decay. One may wander for hours among a maze of roofless rooms, crypts, naves, arches, and grassy patios. From the old bell-tower you may scramble out onto an open

earth-covered section where grass and wild flowers have taken root—a place from which there is a marvelous view of the whole town, as well as of the surrounding mountains. Only one part of the church is still intact, the small chapel of the Third Order. It is there that pilgrims go to find the tomb of Hermano Pedro, and to waken him with three blows of their knuckles (never more and never less), rapping sharply so as to be certain he will hear, before uttering their petitions, for he has been dead now for many years.

Origin of a hospital

Pedro de Betancourt was one of the most unforgettable of the many strange characters in the ancient city. Born in the Canary Islands, he embarked for the New World as a young man, his heart burning with desire to become a Franciscan monk. But there was one insuperable difficulty. Try as he might, studying all day long and far into the night, not a word of Latin could he learn, not a single one of the long liturgies. Finally, however, he was admitted to the Third Order, a sort of auxiliary group, and became inspired to help the sick. He bought a straw-thatched hut in the suburbs and often transported the leprous and plague-stricken to it on his own back. Other monks joined him, and the

▼ DANCE OF THE CONQUEST. The *fiesta* costumes of the young nobles in colonial days so impressed the Indians that they copy them today for their favorite dance. This depicts the defeat of their ancestors by the Spaniards. Here Tecum Uman, valiant Indian leader, is reciting his death speech



was granted money for a better building. Today the hospital he founded is still used by the people of Antigua.

Brother Pedro felt himself called upon to save sick souls as well as sick bodies, and nightly he used to walk up and down the streets, ringing his little bell and chanting:

"Hermanos, hermanos!
Peregrinos somos y por el mundo vamos!
Un alma tenemos y si la perdemos
No la recobramos!"

("Brothers, brothers! Pilgrims we are, and through the world we go! One soul we have, and if we lose it, we cannot regain it!")

Hermano Pedro is said to have performed many miracles and is now being considered for canonization. All about his shrine hang little wax votive offerings—tiny figures of men and women, arms and legs, hearts and eyes—placed there in gratitude by sufferers who believe themselves to have been healed through his intercession. In the rear of the chapel stands an Indian-colored Christ with long brown curls of real hair and a crimson robe —a tired, sorrowful figure, bent low beneath a heavy cross, curiously decorated with silver grape leaves. Even in Antigua, which is one of the least Indian cities of Guatemala, the aboriginal keeps breaking through in just such unexpected places.

The little boys who guided me to the ruined convent of Santa Rosa were certain that the statue of a woman with a child in her arms must be the Saint herself. I insisted that it was rather the Virgin Mary, but they remained unconvinced. "Santa Rosa was also a Virgin," one of them explained in the patiently polite tone reserved the world over for ignorant and presumptuous newcomers. "And here all the Virgins have children."

"Yes," echoed the other. "They all have *niños*—the Virgin of Remedies, the Virgin of Health, the Virgin of Solitude—oh, there are many Virgins, and every one has her baby!"

A large number of the old Colonial houses are still standing, their white, cream-colored, or pale pink fronts pushed tight against the narrow sidewalks. Their overhanging eaves are covered with hard brown or dull red tiles, their windows guarded by iron or turned-wood rails. The studded doors, hung upon great ornamental hinges, are furnished with wrought-iron knockers, generally in the form of a disembodied hand that seems to reach forth in ghostly fashion out of the past. Some of these buildings are in a ruined condition, but in recent years a number of them have been repaired by well-to-do families.

Best-known of all is the Popenoe House, the property of an American who has lived for many years in Guatemala. Much time and effort have been spent in restoring this old house and furnishing it with antique chairs and tables of the style it originally contained, carved wooden plaques and statuettes. There is even an old-fashioned raised fireplace for the kitchen, where dozens of pots and pans hang upon the walls, and an Indian cook takes charge of the preparation of the meals.

Romantic tradition connects this house with the Casa de Los Leones not far away, a building with a curious stone lion on each side of its huge studded doorway. In it lived Don Alvaro de las Asturias who was in love with Doña Beatriz, whose home was what is now the Popenoe House; but her father, Don Teófilo de Alvarenza, disapproved of the match because the young suitor was the son of a merchant. One morning, the body of Don Alvaro was found behind the church of San Francisco, stabbed through the heart. The murderer could not be discovered, but immediately afterward Hermano Pedro began to walk by the home of Don Teófilo very often, tinkling his little bell and chanting his song. This lasted for several weeks, until finally Don Teófilo came out one night, unable to endure it any longer, and admitted that he himself had hired a half-breed to kill Don Alvaro. Next day, he made a formal confession of the crime before the *audiencia*, the royal court. He was sentenced to death on the gallows and hanged in the courtyard of the Palace of the Captains General. A few days later, Doña Beatriz entered the Convent of Santa Clara as a nun.

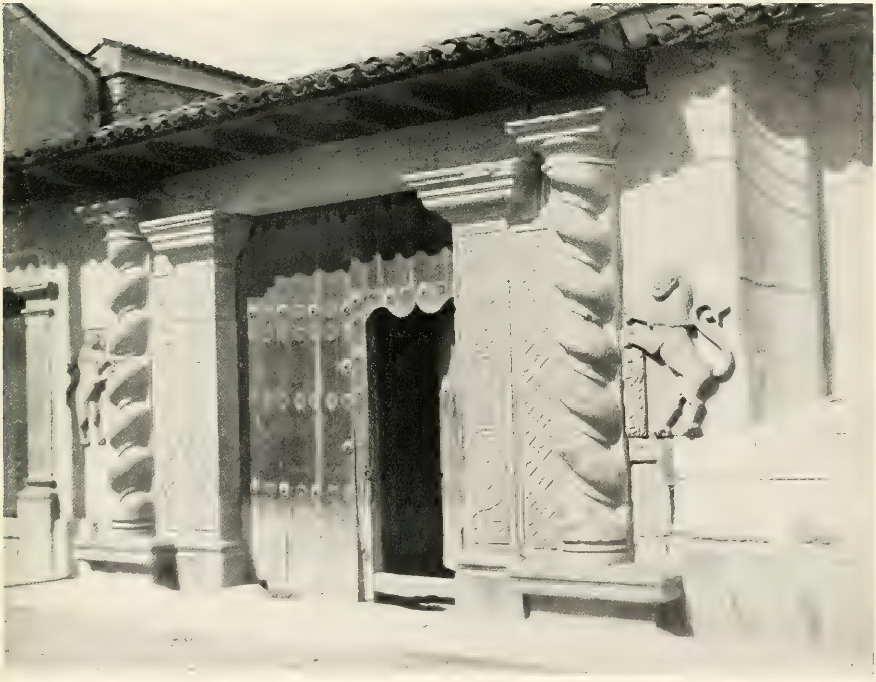
According to common belief, a

$100,000 treasure was hidden somewhere about the premises of the Casa de Rodil, built in 1650 by a Spanish grandee. A former renter found a portion of it, and now the lease states that if the present occupants discover any more, the owners are entitled to a definite part. Another fortune was dug up beneath the "courting seat" of the house across the street. In olden days, most families kept their wealth secreted in such places about their homes, and some of them evidently abandoned their hoards when they left hurriedly during the earthquake. There are also countless legends of other treasures hidden in the mountains by the Indians at the time of the Conquest to prevent their falling into the hands of the Spaniards.

Evening is always a pleasant, tranquil time in Antigua, but Sunday evening is the best of all, for then, even more than on other days, the inhabitants of the town come out of doors and walk slowly about, enjoying the beauty of the sunset and the coolness of the dusk. Gradually the rose and blue of the houses deepen and grow richer; the thick, overhanging eaves throw darker and darker shadows. Windows are flung open; and people sit on the wide sills and on the doorsteps, chatting, singing, and laughing. As the faint sound of a guitar drifts through the darkness, one wonders if the town is essentially very different now from what it was in Colonial days. It is smaller, of course, and less wealthy, and yet it must be even richer in human interest from having lived and enjoyed life so long. The *ladinos* are there still, and the Indians hover in the background as they always have, ever-present, yet never obtrusive. Only the high-born knights and ladies of the olden days are lacking, and their shadows seem to be very near.

The Popenoe House looks a little lonely, with its shutters and doors closed tightly and with no friendly or curious faces peeping out. It seems almost too perfect, with its freshly painted white walls trimmed with rose, its mottled brown tiles and hand-turned wooden *reja* bars—a bit too untouched by life, like one of those saints in Guatemalan churches that have been kept in glass cases and worshipped from a respectful distance. The other houses remind one of those favorite statues that have been prayed to and kissed and wept over, smoked with incense, carried frequently in processions through rough, dusty streets. Yet this house, too, only a few years ago, was but a mass of crumbling ruins, tumbled down by the raging gods of the volcano on that day when the earth trembled and proud men and women, as frightened as naughty children, ran through the streets, confessing their sins aloud, so that all might hear.

▼ "The House of the Lions"—famous in romantic tradition as the residence of Don Alvaro de las Asturias. Don Alvaro was in love with a belle of Antigua, but her father, opposing the marriage, finally had him slain. He was forced to confess by a famous holy man who incessantly rang a bell in the street, calling sinners to repent



HAND COLORING YOUR PICTURES

By CHARLES H. COLES

[illegible]

C[illegible]

[illegible] and greater extent in recent years. But [illegible] natural [illegible] dim illumination, light of incorrect color quality—all make direct color photography out of the question much of the time.

The problem arises quite often when it is found that pictures made in black and white in the past cannot be retaken in color because the former conditions have ceased to exist or because it is not possible to revisit the locality. Still another point to be considered is that large prints from direct color pictures are expensive and not always satisfactory.

A Controlled Color Process

A new process has been developed under the trade name of Crawford Flexichrome that will often bridge the gap between black and white photography and a color picture.

An enlargement of a black and white negative is made on a special film which is processed in a certain way. The back of the film is coated with a white paste that hardens to a white backing to reflect light through the film.

The film is dyed in a black dye solution, whereupon the positive image of the original negative appears. The peculiar property of this black dye is that it may be replaced readily by colored dyes.

The picture is now colored by hand, using special dyes for the purpose. The colored dye actually replaces the black dye and even colors the shadows in the picture, giving the appearance of an actual color photograph if the work is carefully done.

The person who does the coloring must have a certain sense of color, of course, but it is surprising how good a carefully done picture will look. Nothing is permanent until the picture is considered finished. The colors may be changed or adjusted as much as desired. A new color applied to any part of the picture will replace the old color.

Photographs used in certain cigarette advertisements are colored in this way, thereby achieving a brilliance and purity [illegible]

[illegible]

A STRONG PHOTOGRAPH of the type that can be effectively hand colored by the Flexichrome process. In this process, dyes replace the blacks and grays of a specially prepared positive image and can be changed or adjusted until the desired effect is achieved

On a recent occasion this color process made it possible to add an important picture in a Kodachrome series on the dinosaurs that was produced by the American Museum of Natural History. A series of pictures had been taken in color in the Museum and in the field, but a picture was needed that would show the digging up one of the largest specimens. Such a picture had been taken years ago on an expedition but was in black and white. The picture was enlarged and very carefully colored by the Flexichrome process and then photographed in Kodachrome. The result was all that could be desired, and the series completed effectively.

It must be emphasized that this process, if carefully done, will result in a picture exactly like a direct color photograph. No part of the picture need be gray or degraded in color due to an underlying photographic image. The colors may be as pure as desired. It is obvious that the more artistic ability one brings to this task, the finer will be the result, but even the veriest amateur will achieve surprisingly good results, since, as explained before, color values can be adjusted indefinitely until they appear satisfactory.

Hand coloring photographs is a very old method of bringing black and white pictures closer to the truth. The use of transparent water colors was the earliest method, but the newer transparent oils are by far the easier to manipulate.

The picture to be colored should be printed or enlarged on a matte surface paper, not on a glossy paper. A print predominating in lighter tones will be more effective than lower key pictures, because the oils can color lighter areas more brilliantly.

If the original photograph was taken with soft and flat lighting—that is, with the source of illumination behind the cameraman—the picture will be ideal for coloring because of the absence of dark shadows. This type of lighting is usually the best for direct color photography anyway, so, of course, it would naturally be preferred for coloring work, too. A recent display of hand colored pictures

(Continued on page [illegible])

YOUR NEW BOOKS

MONEY BIRD • VIOLETS • SULPHUR • AUSTRALIAN FRONTIER
ASTRONOMY • MAN • CAROLINA BAYS • NEGROES IN BRAZIL

TRAIL OF THE MONEY BIRD

- - - - - - - - - by Dillon Ripley

Harper & Brothers, $3.50

THERE are few travelogues that have both charmed and captivated me like the present one. Ripley succeeds in that most difficult task of a writer, to bring back the atmosphere of the faraway places he has visited. His descriptions are so vivid and expressive that reading them was like being back again in New Guinea and the other places where our trails have crossed.

A naturalist who has been in the interior of New Guinea has enough interesting stories to tell without spoiling them by journalistic exaggeration, as many of the so-called "explorers" do. There are birds of paradise, displaying themselves on their special dancing places; there are bower birds and hornbills. There are curious forest rails that sleep in leaf nests, and there are those most peculiar animals, the giant echidnas. They look like a cross between an anteater and a porcupine, but lay eggs from which suckling young develop.

Even more intriguing than animals and plants are the natives. Ripley lived with the shy Arafuras of Misol Island, with the (ex)pirates of the Schildpad Islands, with the seafaring Biak Islanders and with the primitive woodsmen in the mountains of the Vogelkop. The latter still live in a Stone Age culture but are in many respects more lovable than the more civilized natives of the coastal districts—Suva, Tulagi, Rabaul, Java. These and other places that are now in the news were visited by Ripley and made to live for us in his tale. The word "New Guinea" of the news dispatches has an ugly ring. Those who want to become familiar with the real New Guinea, especially the Dutch part, should entrust themselves to Dillon Ripley. There is no more competent and sympathetic guide.

E. MAYR.

SPEAKING OF MAN

- - - - - - by Michael F. Guyer

Harper & Brothers, $3.50

IN this book a biologist speaks of man. For several years the American Museum has been urged to do something grand and striking in exhibits dealing with the Biology of Man. It is an intriguing idea that somehow the biology of man, if dramatically presented, would save the world by solving our social and economic ills. The tendency is to blame science for all that is wrong and yet to call upon scientists to set our house in order. This book presents a series of interesting chapters inspired by such challenges. The strongest chapters are "Science and its Critics," "The Rise of Intelligent Behavior," and "The Endocrine Control of the Body." The weakest is the chapter dealing with the shortcomings of education, the chief exhibit being a series of college examination boners. Democracy receives attention on eugenic grounds, and the familiar charge is made that the ideal of democracy is abused when it gives the unfit freedom to increase in relative numbers.

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The last chapter considers the impact of science upon religion. The author recognizes the dilemma in that science destroys something vital but offers no substitute. His point of view may be inferred when he writes, "In most individuals there is apparently a subconscious impulse . . . to seek some form of religious guidance."

C .W.

THE ORIGIN OF THE CAROLINA BAYS

- - - - - - - - by Douglas Johnson

Columbia University Press, $4.50

DR. DOUGLAS JOHNSON, Professor of Geology in Columbia University and a leading world geomorphologist, has during the past ten years spent much time in attempting to discover the origin of the so-called Carolina "bays." These formations occur on the coastal plain of North Carolina, South Carolina, and Georgia. Although the bays were known for many years, it was Professors Melton and Schriever who discovered their abundance and remarkable distribution. These shallow depressions with very low rims are hardly noticeable from the ground, but they show up in a striking manner in aerial photographs. By examining such photographs, Melton and Schriever discovered that there were hundreds of "bays" or "craters" of beautifully elliptical shape with their long axes almost parallel and extending in a northwest-southeast direction. It is now known that there are many thousands of them scattered over a 25,000 square mile area.

Melton and Schriever argued that these "bays" were the scars produced by a vast shower of meteorites. Many scientists accepted this theory, but Doctor Johnson has written a book which will raise strong doubts. He carefully studied the aerial photographs and personally examined 127 "bays" on the ground. In his introduction he says that in more than 40 years of geological study, he has encountered no problem so difficult.

The explanation advanced by Doctor Johnson to account for these bays, he modestly calls the hypothesis of complex origin. It seems that he would have been justified in dignifying it by the name theory. It is too complex to be discussed adequately in a brief review, involving as it does artesian spring action and solution; most of the depressions for-

[illegible]

HANDBOOK OF FROGS AND TOADS

by A[illegible] W[illegible] and Al[illegible] H[illegible] W[illegible]

[illegible]

THIS [illegible] naturalist to identify and acquire famil- [illegible] United States. It is all that a handbook [illegible]

The book is the outcome of a lifetime of study and photography. The Wrights first published the results of their activities in 1933 in the first edition of their [illegible] edition, and the enthusiastic reception of the earlier edition proved its desirability.

The revision and consequent expansion have been fairly uniform throughout the [illegible] the fine photographs, illustrating practically every form of frog and toad, and the excellent bibliographies at the end of the book. These have been largely expanded with useful recent additions. The index has been greatly improved through the inclusion of scientific names.

This reviewer finds few faults in the present volume, and these will be of little concern to the student. A number of herpetologists will not completely agree on the systematic arrangement of some forms, but this volume is sure to take its place above its predecessor as the outstanding book on the frogs and toads of the [illegible] [illegible]

OUTLINES OF ECONOMIC ZOOLOGY—Fourth Edition

by [illegible] M. Reese

The Blakiston Co., $3.25

THIS is a systematic review in outline of the entire animal kingdom, from the microscopic single-celled animals of various human diseases, to the giant whale which may yield "30 tons or more" of oil. Animal by animal, group by group, there is statement of the obvious values or harmfulness of each to mankind, with methods of its utilization or control.

It is a great convenience to have tangible data on so broad a subject accessible in one small volume, and familiarity with its pages will be an excellent introduc- [illegible] permits of only the briefest statements, and there is little attempt to discuss, follow, or visualize the often intricate problems of this science, or the balance of nature on which it so largely depends. We read that the starfish eats quantities of oysters, which is true, though hard to believe until one has learned (elsewhere) how it does it,—that the horseshoe crab is caught "by the ton" at Delaware Bay [illegible] fertilizer. That by eating starfish eggs the horseshoe crab is a natural, if sometimes inadequate check on the starfish is not mentioned. Perhaps the intricacies of economics are as little followed. That the price of whalebone (once of great commercial and now of very little value) "has fluctuated" and "in 1940 was about 17½ cents per pound,"—in what must be a very limited market, is misleading.

Nevertheless, we have here a very interesting book, and one equally useful for reference, as is attested by this being its fourth edition. An excellent index makes the large amount and variety of factual material accessible, and there is also an extensive bibliography. It is attractively and durably made, as such a book should be.

J. T. N.

ASTRONOMY, MAPS, AND WEATHER

by C. C. Wylie

Harper & Brothers, $3.00

THE author, who is professor of Astronomy in the University of Iowa, has given us a book on a surprising combination of subjects, perhaps never before included in one book. The reason for combining astronomy and meteorology is explained in the preface, where we learn that the book was prepared at the request of the Army Air Corps Flying Training Command, Doctor Wylie being a member of a committee nominated by Doctor F. R. Moulton, Permanent Secretary of the American Association for the Advancement of Science.

The first part, consisting of six chapters, treats of the fundamental circles of the celestial sphere, telescopes, the earth, the seasons and the calendar, the constellations and navigation stars. Besides northern and southern circumpolar star charts, there are twelve excellent star charts for 40 degrees north latitude. It would have been helpful to have had the same number for 40 degrees south latitude, since the constellations appear and "behave" so differently south of the equator.

The second part, consisting of three chapters, treats of weather, clouds, and weather forecasting. Beautiful photographs of the various types of clouds and other atmospheric phenomena are shown.

The third part, also of three chapters, treats of maps and map-making, time, and celestial navigation, with numerous helpful illustrations.

The fourth part, consisting of eight chapters, which might be called a survey course in general astronomy is not a "required" part of the course, but was written for those pilots who may become interested in securing a more complete knowledge of the sun, moon, planets, stars, and galaxies.

[illegible] W[illegible] has produced a very practical and most attractive book for the [illegible] commended.

C[illegible] F[illegible]

THE STONE THAT BURNS

The Story of the American Sulphur Industry

by William Haynes

Van Nostrand Company, $3.75

TO those who are more or less familiar with it, the story of the mining of sulphur by the ingenious Frasch process is [illegible] of the most notable American industrial achievements. But to most people it was a finished story, once the process was conceived and found to work. We find, however, on reading this book, that there were many more obstacles to overcome and that Frasch's genius was truly a remarkable possession. Herman Frasch had already demonstrated his ability by inventions in the oil industry, before turning his attention to the baffling problem of the recovery of sulphur overlain by a hydrogen sulphide impregnated, water-filled layer of quicksand. When he suggested melting it in place and pumping it out of the porous rock, it seemed to many to be a fantastic idea. Even though it worked, the difficulties were not all so simply solved. There were many subsequent headaches in the sulphur business, and each of them required a little additional ingenuity and American inventiveness.

William Haynes has done a splendid job of assembling all the data of the industry's history, and his account is carefully and fully documented with many references. It is a story of today's sulphur companies and of men who are still alive, and it brings the industry right down to the present. There is doubtless far more detail than will interest many general readers, but those with a special interest in the chemical field will find it a fascinating tale throughout. The general reader will certainly find the first half, with its account of the pioneer work of the Union Sulphur Company and the trials of the Sicilian sulphur producers, well worth his attention.

F. H. POUGH.

THE IVORY-BILLED WOODPECKER

by James T. Tanner

National Audubon Society, $2.50

AMONG the North American birds fast nearing extinction, the strikingly handsome ivory-billed woodpecker is one that demands immediate attention if it is not to disappear completely from the living fauna. In order to learn as much as possible about the bird before it was too late, and to discover what means must be adopted to preserve its last survivors, Mr. Tanner was commissioned by the National Audubon Society to study it in its now restricted haunts and to explore its former range to learn what he could of the causes of its disappearance. The present report deals with the results of this survey, which occupied a total of about 21 months in the field.

Space does not permit a detailed summary of Mr. Tanner's findings. He discovered a probable maximum of 22 birds still living in 1939 in Florida and Louisiana, with the possibility of others in South Carolina. He ascribes the bird's disappearance from much of its former range to logging operations and the consequent absence of recently dead trees and their wood-boring-insect population on which the birds depend for food. He insists that any measures for the rehabilitation of the ivory-bill must depend on the preservation of an adequate area of suitable timber, either in a perfectly natural condition or subject only to selective logging in order to offer the primary feeding and nesting requirements of the species. Given the best possible conditions, with complete protection, the ivory-bill may yet be saved from extinction.

Details of appearance, behavior, food, distribution, population density, past and present ranges, and similar facts are each discussed in some detail, and the brochure is illustrated with a colored frontispiece, photographs, and line drawings. It is highly recommended to everyone interested in conservation and especially in the preservation of this largest and finest of the North American woodpeckers.

John T. Zimmer.

WILD VIOLETS OF NORTH AMERICA

- - - - - by Viola Brainerd Baird

University of California Press, $10.00

IT is most fitting that this book should be prepared by Viola Brainerd Baird, for she is the daughter of the late Ezra Brainerd, leading authority on the violets of North America. Her father is the author of *Violets of North America,* and it was he who revised the section on violets for the last edition of Gray's *Manual.*

Not only did Mrs. Baird draw heavily on the classic work of her father, but she has combined it with the results of subsequent research in this field. She gives us an up to date book, which by means of text, keys, and illustrations makes it possible for anyone, whether amateur or professional, to identify any species of violet known in the area considered.

In North America north of Mexico there are some 77 different species of wild violets. All of the full species except one, together with several subspecies, have been done in full-page color plates by the well-known artist and naturalist, the late F. Schuyler Mathews. These excellent drawings in color are supplemented by many helpful line drawings. The paintings in color and the line drawings were made in almost every case from fresh living specimens. And the description of each violet was made with the growing plant at hand.

The descriptions of the violets include both the flowering and the mature stages, for, as the author's father wrote, "Violets are much alike at flowering time, but only in late summer are marked specific characters developed. Then the mature leaves, the closed flowers, their peduncles, sepals, capsules, and ripe seeds all reveal striking differences. With this knowledge at hand, a child may be taught to distinguish the species."

Here is a beautiful book, both scientifically accurate and popularly written.

Clyde Fisher.

GEOLOGY IN THE MUSEUM

- - - - - - - - - by F. J. North
C. F. Davidson and W. E. Swinton

Oxford University Press,
for
The Museums Association, $1.50

THIS handbook is designed to furnish some details of geological museum technique for the assistance of curators in general and local museums. It is concerned with the preparation, preservation, cataloguing, and, to a lesser extent, the exhibition of geological, mineralogical, and paleontological specimens. A number of "recipes" and techniques employed in the museum are described and their problems and advantages outlined. It is this content which makes this work of great value to the average collector and student to whom it is sincerely recommended.

H. E. Vokes.

AUSTRALIAN FRONTIER

- - - - - - - - - by Ernestine Hill

Doubleday Doran & Co., $3.50

IN this timely book northwest and central Australia are described, a part of Australia which will be much better known after this war to many of our American soldiers than to most Australian city dwellers.

Starting off by plane but later using any available means of transportation, the author traveled northward along the

Continued on next page

SECOND FRONT PHOTOGRAPHS

Because many readers of Natural History are travelers, attention is called to the fact that the Office of Strategic Services is on the hunt for photographs showing the terrain of foreign lands that may possibly become theaters of war. All photographs from a European tour or world cruise which show landscapes, harbors, beaches, docks, factories, oil depots, and railroads are sought. The pictures themselves should not be sent at this time. Send an outline of what you have to the Office of Strategic Services, Station G, Box 46, New York City.

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INFORMATION TEST

A few high spots in this issue on which you can try your knowledge

[illegible]

1. [illegible]

2. [illegible]
   a. A bomb that hits your roof.
   b. [illegible] porch.
   c. [illegible]

3. [illegible]

4. A flying fox is not a fox at all. What is it?

5. [illegible]
   a. nine months
   b. [illegible]
   c. [illegible]

6. [illegible] tegic, not the refined metal.
   True False

7. When an animal sleeps all winter in-[illegible] its fat.
   True False

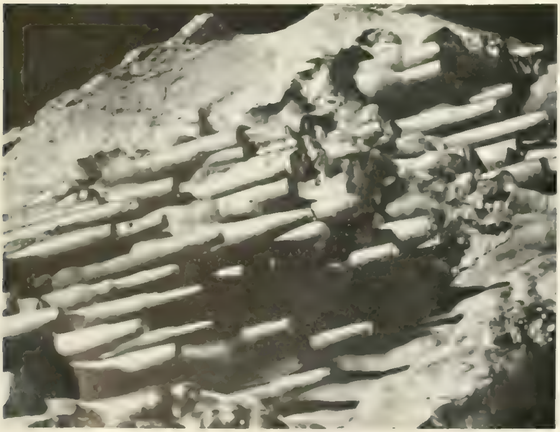
8. Buffalo Bill never slew a single buffalo.
   True False

9. [illegible] body temperature, normally about the same as ours, falls to:
   a. 73° F.
   b. 73° C.
   c. 37° F.
   d. 37° C.

10. Since 7% of the earth's crust is aluminum and few elements are more abundant, why is it of strategic importance?

11. The photograph below depicts (a) The guns of Bataan, (b) unfinished rifle cartridges, (c) the terrific sinews of war?

[illegible]



[illegible] and deserted mining towns and talked with old prospectors and lonely station managers, gathering tales of adventure, romance, and violence.

Many parts of this northwest coastal region are blessed with a wealth of gold [illegible] hurricanes, droughts, and floods. Pearlfishing brings a good living to many and wealth to a lucky few, while cattle raising is carried on extensively and meat-packing is an important seasonal industry. Men work against fearful odds in this wind-swept land where whole towns [illegible] during the worst storms.

Aborigines live there in semiwildness working for the white men in mines and on cattle stations. They cling to their old tribal rituals and corroborrees. These native dances are a reenactment of important events and may be dramatic, humorous, or burlesque.

Jumping from the Northern Territory to Central Australia, Miss Hill traveled north from Port Augusta across the saltbush plains, which are treeless, waterless, and level as the ocean. She tells absorbing tales of camels and Afghans; of opal diggings and an underground community; of a gold rush, and of an English woman who married an aboriginal and has lived among her husband's people for many years.

[illegible]

NEGROES IN BRAZIL

by Donald Pierson

University of Chicago Press, $4.50

ONE of the inescapable consequences of the overflow of Europe after 1492 was the [illegible] of contact between racial groups that had previously been isolated from each other. This process was nowhere more significant than in the New World, although important centers of race contact and miscegenation grew up in various parts of the newly discovered Old World. It would be a mistake to regard these foci of contact as of parochial interest only. On the contrary, they have an [illegible] significance in a world where distances are rapidly shrinking and transportation is becoming increasingly easy. They are tokens of a process that is likely to spread over a much greater part of the earth than they now affect.

Mr. Pierson has selected Brazil as one of these areas of contact and has described in some detail the history and nature of the relationships among Indian, Negro, and White. Most of his discussion, however, necessarily hinges upon the two latter groups since the Indians constitute a relatively minor group. Nowhere in the New World did the traffic in Negro slaves exceed the numbers imported into Brazil. Moreover, slavery nowhere else in the New World continued as late. In spite of these circumstances, or perhaps because of them, Mr. Pierson finds that the Negroes of Brazil enjoy a much more equable position in Brazilian life than in the United States or South Africa. The picture Mr. Pierson draws of the social status of the Bahian Negro of Brazil is of great importance in understanding the relationships of the Negro elsewhere.

H. L. S.

MEET THE NATIVES

------ by M. Walter Pesman

Published by the Author,
3722 South Humboldt St.
Denver, Colo.
$1.25

THE author, who is an instructor at the University of Denver, has prepared a most usable and attractive little book for identifying wild flowers, trees, and shrubs of the Central Rocky Mountain Region. He begins his introduction as follows: "Dear Plantlover: Just between you and me—don't buy this book if you know too much. This is not a book for botanists."

Over 700 plants are classified,—first, according to life zone where the plant grows; second, according to color; and third, according to season. More than 150 of the more conspicuous or striking plants are illustrated by good, clear pen drawings. Those of similar color and common to the same zone are grouped on the same page. Some 50 other plants are illustrated by excellent photographs.

The first or major grouping is by life zones as they occur in Colorado: Plains Zone from 3,500 to 6,000 feet elevation; Foothill Zone from 6,000 to 8,000 feet; Montane Zone from 8,000 to 10,000 feet; Sub-alpine Zone from 10,000 to 11,500 feet; and Alpine Zone from 11,500 feet to the tops of the highest peaks.

Under each life zone, the plants are grouped according to color of flowers, and are described on pages of appropriately colored paper. For example, trees on green paper; red, pink, and reddish-purple herbs on pink paper; white herbs on white paper; blue and bluish-purple herbs on blue paper; yellow herbs on yellow paper. This unique device saves time in looking up a plant.

CLYDE FISHER.

EVOLUTION OF BOOKBINDING

A special exhibition of books bound in wild animal skins, will be shown at the American Museum of Natural History, from December 2nd through January 20th. The books were bound by Hamonneau, master binder, who has utilized lion, rhino, elephant, skunk, and about 25 other skins. The exhibition will demonstrate the development of the uses of various materials, from the parchment of 1,000 years ago, to present-day bindings.

HAND COLORING YOUR PICTURES

Continued from page 270

taken under flat illumination caused a great deal of comment by their close resemblance to direct color pictures, for which they were often mistaken at first glance.

Coloring Pictures

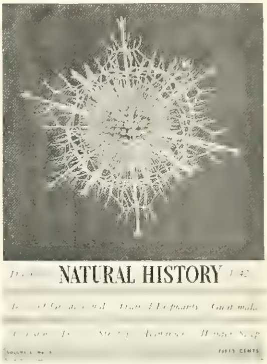
Transparent oils are the easiest type of coloring to use because mistakes are not fatal. If one color accidentally runs over onto another, it may be removed readily and the coloring reapplied. Large areas like the sky may be covered smoothly with no more trouble than merely rubbing the color over the area with a tuft of cotton. Of course, a deep gray sky such as is obtained with a heavy filter is very difficult to color. The sky as produced by an orthochromatic film without a filter—that is, a very light or even white sky—is preferable. If a picture with a gray sky must be used, it might simplify matters to tone the entire print blue chemically before coloring it.

While it is recognized that there is nothing like a direct color picture for accuracy, beauty, and simplicity, there should be no reason to overlook the opportunities that hand coloring can open up as a substitute for direct color photography. The work itself is creative fun for otherwise empty winter evenings, and a carefully done job is a close approach to a real color picture—so close that many of the pictures you see in magazines and assume to be direct color shots are really hand colored.

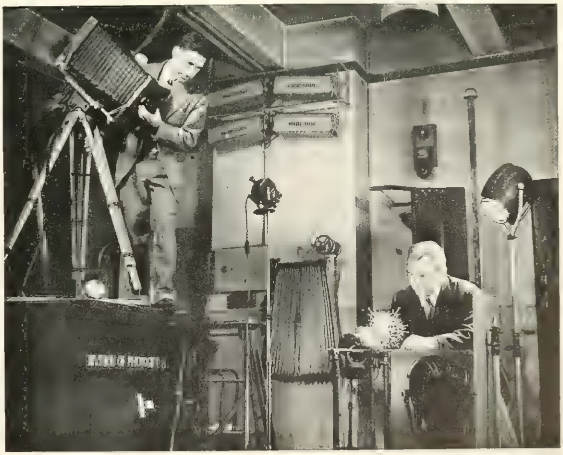
THE COVER THIS MONTH

The delicate glass model on the cover of this issue represents the small one-celled animal *Lychnosphaera regina,* greatly enlarged. This tiny protozoan inhabits the surface waters of the Central Pacific. It has a lattice-like glassy skeleton of fragile beauty surrounding the rose-colored clustered lobes of the living animal in the center. Threadlike filaments radiate in all directions to capture still smaller creatures.

The model was created by Herman Mueller, the American Museum's skillful glass blower, under the direction of Dr. Roy Waldo Miner, whose article on page 252 describes the universe of minute creatures that is revealed by the microscope. Mr. Mueller is shown below assisting Charles H. Coles, the Chief Photographer, in photographing the model in color. The model was rested on a plate glass platform under the carefully adjusted beams of five spotlights. Three filters were used, one of them polarized to control reflections. The most highly color-corrected lens available was stopped down to a pinpoint, and an exposure of fifteen minutes was given.



Photographed by Charles H. Coles



[illegible]

New York, N. Y.

Sirs:

[illegible] which were very evident on the bare [illegible] wooden stake into the ground, the stake having been made of a board an inch or less thick and some four inches wide. Another board of similar thickness and width and some three or four feet long was then rubbed across the top of the stake at an angle that would cause the stake to vibrate. Sometimes a flat piece of rusty iron was used instead of the wooden board [illegible]

I should like to give the result of one [illegible] day, when no earthworms were to be seen on the surface of the ground—although there were plenty of "signs"—, two com[illegible] case in which I counted the earthworms. [illegible]

New York, N. Y.

[illegible] them to do so, and anyone who undertakes to test the efficacy of any [illegible] into account.—Ed.

* * *

Sirs:

In connection with the ancient story that bees can be born out of the bodies of lions, the author of "Knothole Cavern" in [illegible] oldest food firms in England. The labels of the Lyle Company—makers of syrups and honeys—depict a dead lion enveloped by a swarm of "bees," with the motto: "Out of strength cometh forth sweetness."

[illegible]

Tucson, Ariz.

* * *

Sirs:

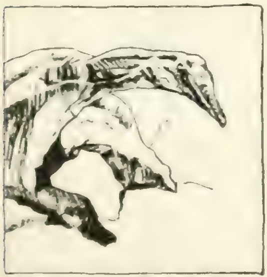
. . . Your publication is a great joy to our school . . . Gladys M. Bates.

[illegible]

Sirs:

[illegible] Vokes' explanation of how Nature carved the natural bridges.

As I am not a scientist but only a dreamy artist, I have my own ideas about the origin of Twinbow Arch, depicted on the cover of Natural History. I am convinced that a nice old dinosaur knew al[illegible]

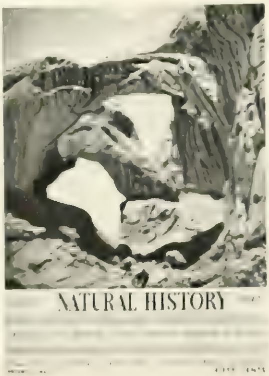


[illegible] pothesis, even though you will note that this drawing is traced directly from the old beast, without changing a line. But [illegible] tion when dealing with scientific problems.

Moreover, I want to tell you that Natural History is the magazine I am always waiting for like a child for Christmas.

[illegible]

Plainfield, N. J.



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yearling head down
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[illegible]

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